

S. 4, THE NATIONAL COMPETITIVENESS ACT OF 1993

C 73/7: S. HRG. 103-68

National Competitiveness Act of...

HEARINGS

BEFORE THE

COMMITTEE ON COMMERCE,
SCIENCE, AND TRANSPORTATION
UNITED STATES SENATE

ONE HUNDRED THIRD CONGRESS

FIRST SESSION

FEBRUARY 24, AND MARCH 25, 1993

Printed for the use of the Committee on Commerce, Science, and Transportation



U.S. GOVERNMENT PRINTING OFFICE

65-443cc

WASHINGTON : 1993

For sale by the U.S. Government Printing Office
Superintendent of Documents, Congressional Sales Office, Washington, DC 20402

ISBN 0-16-040948-9

S. 4, THE NATIONAL COMPETITIVENESS ACT OF 1993

. C 73/7: S. HRG. 103-68

National Competitiveness Act of...

HEARINGS

BEFORE THE

COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION UNITED STATES SENATE

ONE HUNDRED THIRD CONGRESS

FIRST SESSION

FEBRUARY 24, AND MARCH 25, 1993

Printed for the use of the Committee on Commerce, Science, and Transportation



U.S. GOVERNMENT PRINTING OFFICE

WASHINGTON : 1993

65-443cc

For sale by the U.S. Government Printing Office
Superintendent of Documents, Congressional Sales Office, Washington, DC 20402

ISBN 0-16-040948-9

COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION

ERNEST F. HOLLINGS, South Carolina, *Chairman*

DANIEL K. INOUE, Hawaii

WENDELL H. FORD, Kentucky

J. JAMES EXON, Nebraska

JOHN D. ROCKEFELLER IV, West Virginia

JOHN F. KERRY, Massachusetts

JOHN B. BREAU, Louisiana

RICHARD H. BRYAN, Nevada

CHARLES S. ROBB, Virginia

BYRON L. DORGAN, North Dakota

BOB KRUEGER, Texas

JOHN C. DANFORTH, Missouri

BOB PACKWOOD, Oregon

LARRY PRESSLER, South Dakota

TED STEVENS, Alaska

JOHN MCCAIN, Arizona

CONRAD BURNS, Montana

SLADE GORTON, Washington

TRENT LOTT, Mississippi

JUDD GREGG, New Hampshire

KEVIN G. CURTIN, *Chief Counsel and Staff Director*

JONATHAN CHAMBERS, *Republican Staff Director*

C O N T E N T S

FEBRUARY 24, 1993

	Page
Opening statement of Senator Burns	12
Prepared statement	13
Opening statement of Senator Danforth	3
Opening statement of Senator Hollings	1
Prepared statement	2
Opening statement of Senator Rockefeller	3
Prepared statement	3
Prepared statement of Senator Bryan	14

WITNESS

Brown, Ronald H., Secretary of Commerce	4
Prepared statement	8

MARCH 25, 1993

Opening statement of Senator Burns	88
Prepared statement	107
Opening statement of Senator Exon	89
Opening statement of Senator Rockefeller	95
Opening statements of Senator Hollings	61, 62
Prepared statement	62

LIST OF WITNESSES

Brooks, George, on behalf of the National Coalition for Advanced Manufacturing	80
Carlisle, Brian R., Chairman and CEO, Adept Technology, Inc., on behalf of the American Electronics Association	66
Prepared statement	68
Davis, Don H., Jr., National Coalition for Advanced Manufacturing, prepared statement of	83
Joseph, Brian E., Laboratory Director, Touchstone Research Laboratory	137
Prepared statement	138
Kerrey, Hon. Robert, U.S. Senator from Nebraska	99
Prepared statement	102
Kilcrease, Dr. Priscilla, Deputy Commissioner for Research and Sponsored Programs, Board of Regents of the State of Louisiana	108
Prepared statement	111
Lucky, Robert W., Ph.D., Vice President of Applied Research, Bellcore	127
Prepared statement	130
Myhrvold, Dr. Nathan P., Vice President, Advanced Technology and Business Development, Microsoft Corp	120
Prepared statement	122
Prestowitz, Clyde V., President, Economic Strategy Institute	64
Siegenderf, W.J., Vice President, Hewitt-Robins	142
Prepared statement	144

APPENDIX

Computer Systems Policy Project, prepared statement of	153
--	-----

	Page
Questions asked by Senator Burns and answers thereto by:	
Mr. Lucky	168
Mr. Myhrvold	166
Secretary Brown	158
Questions asked by Senator Pressler and answers thereto by Secretary	
Brown	164
White, Dr. Robert M., National Academy of Engineering, prepared statement	
of	151

S. 4, THE NATIONAL COMPETITIVENESS ACT OF 1993

WEDNESDAY, FEBRUARY 24, 1993

U.S. SENATE,
COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION,
Washington, DC.

The committee met, pursuant to notice, at 9:32 a.m. in room SR-253, Russell Senate Office Building, Hon. Ernest F. Hollings (chairman of the committee) presiding.

Staff members assigned to this hearing: Patrick H. Windham, professional staff member; and Louis C. Whitsett, minority staff counsel.

OPENING STATEMENT OF SENATOR HOLLINGS

The CHAIRMAN. Good morning. The committee will come to order. We welcome Secretary Brown. This is our initial hearing this year with respect to technology and trade policy. This does commence a dramatic change with respect to America's competitiveness.

Article 1, Section 8 of the Constitution says that the Congress shall have the power to regulate foreign commerce. And as a result, the original committee here that we chair used to be the Committee on Foreign Commerce. Then it was the Committee on Foreign and Interstate Commerce. Then, over the years, there was an almost fetish to not do anything about commerce. And since commerce had nothing much to do, they gave us space, science, and transportation. And so now we are the Committee on Commerce, Science, and Transportation.

The efforts by this committee and others over the years now have been met with almost stonewalling—people saying “wait a minute, you cannot do that.” You cannot get into commerce. You cannot do what the constitution says do; namely regulate commerce; that that would be setting industrial policy.

And with that fetish in mind, we had to veritably sneak onto the 1988 Trade Act a technology initiative resolving our National Bureau of Standards into the National Institute of Standards and Technology, instituting the Advanced Technology Program, and the manufacturing centers, and the research and extension services for small businesses in particular.

That has been stultified with a very, very small appropriation, and I was very, very encouraged to see business leaders over the past year like Scully of Apple, and Mr. Young of Hewlett-Packard, say that they support the President's proposal that rather than 7 manufacturing centers what we needed was 170. I think that is a

little ambitious under our financial constraints, but at least it dramatizes a change in direction that we need.

We have a bill in, S. 4, that encompasses those embellishments, on the one hand, and the superhighway of information, the initiative of Vice President Gore, on the other hand. We will now be glad to hear from the Secretary.

I have prepared comments, and we will insert those in the record.

[The prepared statement of Chairman Hollings follows:]

PREPARED STATEMENT OF SENATOR HOLLINGS

Good morning, and welcome to this Committee hearing on S. 4, the National Competitiveness Act. This bill has two main purposes. First, it significantly upgrades the technology and manufacturing programs of the Department of Commerce (DOC), in order to help U.S. industry to improve competitiveness and create jobs. Second, it contains Vice President Gore's proposal to support industry's research efforts to develop advanced computer technologies and applications—technologies and applications that will help companies make more efficient use of the Nation's private telecommunications networks.

Technology has never been more important to the Nation's future. Americans know that we must become more competitive in this post-Cold War world, and that staying ahead in technology is vital to our jobs and our prosperity.

Today's hearing is particularly timely. Just a week ago today, the President addressed Congress on the economy, and issued an accompanying report that proposed significant increases for civilian technology programs, particularly those DOC programs which support industry's efforts to stay at the cutting edge of technology. The President proposed for fiscal year 1993 a supplemental appropriation of \$103 million for DOC's Advanced Technology Program, and proposed that the overall budget of DOC's National Institute of Standards and Technology (NIST) rise to \$1.2 billion by FY 1997, from the current FY 1993 level of \$384 million. Then just this past Monday, the President announced a far-reaching technology policy which, for the first time, made economic growth and jobs among the highest priorities for Federal science and technology policy. A sea-change is under way in Federal research policy, and civilian technology will no longer be a step-child.

In my view, S. 4 can play an important role in advancing these new economic priorities. I am very pleased that this morning the distinguished Secretary of Commerce is here to present the Administration's views on S. 4 and to discuss the bill in the context of the President's overall technology policy.

In starting this hearing, I stress that we must ensure that the Federal Government's \$70 billion annual research budget is made more useful to U.S. industry. At a time when other countries continue to help their firms, and when long-term investments in new technologies can pay huge economic dividends, the Government has a major responsibility—to support industry's own efforts to speed the commercialization of new technologies, improve manufacturing, and save jobs. Just as the Land Grant Universities and agricultural extension helped the U.S. become the world's leader in agriculture, so support for industry-led research and for manufacturing extension can help restore prosperity and growth to U.S. industry.

Second, as important as it is, good technology is not enough by itself to ensure U.S. competitiveness and prosperity. Other steps are equally vital, and here too the Commerce Department has a crucial role to play. We need, at a minimum, strict enforcement of our trade laws, particularly antidumping statutes. Good technology will not be enough if others are allowed to use predatory pricing to wipe out American companies. We must also create the right financial climate. We must begin by controlling the Federal deficit. Then we must add the right incentives, such as an investment tax credit and perhaps other forms of financial assistance. Finally, we need to be creative—to use new thinking—about other ways government can help. For example, we should free excess radio spectrum so that private industry can develop new wireless communications technologies. In short, we must pay attention to both technology and these other components of competitiveness.

The Commerce Committee will be active this year, not only on technology policy but also competitiveness in general. S. 4, is vital, and the Committee will move it quickly. But the Committee also will continue to work on competitiveness issues, looking, for example, at key industries to see how Federal technology policies and other policies can promote U.S. competitiveness and jobs. The Clinton Administra-

tion is already talking about sectors such as advanced manufacturing, aerospace, and automobiles. The Commerce Committee will be a leader on these issues.

Mr. Secretary, we welcome you to your first appearance before this Committee since your confirmation hearing, and we very much look forward to your testimony and to the opportunity to work with you on this legislation. We would be delighted to hear from you at this time.

The CHAIRMAN. Let me yield to Senator Danforth.

OPENING STATEMENT OF SENATOR DANFORTH

Senator DANFORTH. Mr. Chairman, thank you very much. Secretary Bentsen is appearing in the Finance Committee at 10 o'clock on the economic program, and I am going to be leaving for that in about 15 minutes. But I did want to make an appearance here this morning, and to pay my respects to the Secretary of Commerce and to welcome him back to the committee.

The CHAIRMAN. Thank you. Senator Rockefeller.

OPENING STATEMENT OF SENATOR ROCKEFELLER

Senator ROCKEFELLER. Thank you, Mr. Chairman. I also have a Finance Committee meeting at 10 o'clock, but I am choosing the Secretary that I am looking at over the one that I cannot see to be with this morning. So, Mr. Danforth will have to represent me at the Finance Committee hearing.

Senator DANFORTH. I would be happy to. [Laughter.]

Senator ROCKEFELLER. I would just say, Mr. Chairman, that Secretary Brown's own Commerce Department has concluded that in 1990 that we are falling behind Japan in 10 out of the 12 emerging technologies that are considered to be the most important. And, therefore, this whole concept of having an administration now which is looking forward to addressing problems like this with the so-called partnership where it is appropriate is a breath of fresh air that I simply cannot describe the pleasure of inhaling. Now that is not the word we want to use, is it. [Laughter.]

So, I just want to say that this hearing this morning with the Secretary discussing S. 4, which is Chairman Hollings' initiative, something which I participated in, is something I am really looking forward to.

[The prepared statement of Senator Rockefeller follows:]

PREPARED STATEMENT OF SENATOR ROCKEFELLER

This hearing represents an important milestone. For years, members of the Senate and this committee—Republicans and Democrats alike—have been convinced that our nation's competitiveness can, and should, be enhanced by government policies which support the development and commercialization of new technologies. Now, we have an administration which agrees: that technology and manufacturing are important, and that it is in the national interest for government to work with industry in promoting them.

Secretary Brown's own department concluded in 1990 that we are falling behind Japan in 10 of the 12 most important emerging technologies. The technology policy the President himself unveiled on Monday indicates we now have a Commerce Department able to acknowledge the implications of its own report and committed to taking actions to reverse this trend.

I think the President's technology proposals are exactly on the mark. He promised during the campaign to present policies to spur long-term economic growth and worker productivity. His proposals will do exactly that. Especially in my capacity as Chairman of the Senate's Science, Technology, and Space Subcommittee, I look forward to working with you, Secretary Brown, and other members of the Clinton Administration to make these proposals a reality.

As a Senator from West Virginia, a state that is not the home to many big companies, I am particularly pleased to see the emphasis on small business and on small scale research and development programs. The big technology projects boost our national prestige but the small projects boost our national competitiveness and our national standard of living. The big technology projects create tens of thousands of jobs for government workers and government contractors but the small projects supported by the Commerce Department will lead to the creation of new high-tech companies, new industries, and hundreds of thousands—and eventually millions—of new high-skill, high-wage, private sector jobs.

Speaking as one of the authors of S. 4 (along with our distinguished chairman), I can say the National Competitiveness Act of 1993 is also intended to reverse recent trends. Our strategy in the bill is to take an integrated approach to the activities that impact on our competitiveness. We focus on research and development, technology commercialization, manufacturing extension, training, and education—all essential to the restoration of a competitive industrial base.

S. 4 focuses specifically on the commercialization and extension parts of government policy. I am particularly interested in our call for the expansion of the Manufacturing Technology Centers Program and the State Technology Extension Program, both of which help get the latest in manufacturing technology out to smaller businesses that may not know about it.

Finally, S. 4 proposes both a new commercialization loan program similar to what Congressman Mineta and I have been proposing and for a variation on the Advanced Technologies Capital Consortium I proposed a year ago. These are meant to be initiatives that will help move good ideas out of the laboratory and into the marketplace. This has historically been the weak link in our technology commercialization chain.

I look forward to working with you, Secretary Brown, and with your department to combine the proposals in S. 4 with the new technology initiatives that the President just announced. I hope, Mr. Secretary, that your testimony will be a strong endorsement of the technology commercialization effort this committee has been working to develop over several years. It appears to me that the Congress and the administration are finally moving in the same direction. I know this committee is ready to work with you to fashion a superb final product.

The CHAIRMAN. Very good. We are delighted now to hear from you, Mr. Secretary.

STATEMENT OF RONALD H. BROWN, SECRETARY OF COMMERCE

Secretary BROWN. Thank you very much, Mr. Chairman, and Senator Danforth, and Senator Rockefeller. It is a real pleasure for me to be back before you this morning on this very important piece of legislation.

I might begin by introducing someone who I hope will soon be an official colleague of mine. He happens to be in the hearing room this morning. I had an opportunity to introduce him to Senator Hollings. And that is the individual who President Clinton has announced his intention to nominate as the Deputy Secretary of Commerce. That is, Mr. John Rollwagen. If you would just stand and be recognized, we would appreciate it.

The CHAIRMAN. We welcome him back to the committee. He has been here many more times than you have. Just get his nomination sent up. What is the matter with you?

Secretary BROWN. We are moving on it, Senator, as soon as we can. Let me indicate that I believe this is a terribly, terribly important piece of legislation. I have a longer statement which I would appreciate being included in the record, and I would like to summarize it if I might.

The CHAIRMAN. Yes, sir.

Secretary BROWN. I would like to discuss with you how this legislation, together with the vision that I have formulated for the De-

partment of Commerce, will further President Clinton's agenda, promote economic growth, and create jobs for the American people.

A week ago, the President introduced his economic plan. The goals of that plan are obvious—to create jobs and to ensure long-term prosperity by enacting a stimulus program, investing in our future while at the same time we cut our massive budget deficit.

Mr. Chairman, I spent the 2 days after the President's address in both New York and Chicago. What I found was not really surprising. The American people want their Government to work. They want the gridlock to be broken. They want this President to succeed. They want to reach the goals that this economic program is designed to achieve, and they believe that we can be successful.

The American people do not believe that the best days are behind us, or that we are faced with inevitable decline. They have hope, and the President's plan will reward that hope.

The vision of the plan includes—indeed, it is the same as the vision of S. 4. The President's plan will make the Department of Commerce a focal point for civilian technology.

We will help to forge a national economic strategy through the close cooperation of Government and business. We will do so by drawing upon the insights of S. 4 and earlier legislative efforts to ensure that economic growth in America is powered by the engine of technological progress.

We will do so by creating an extraordinary public-private partnership that will couple governmental assistance with the vigor of the marketplace. And as we do so, we must remember that technology is more than machines and markets. It is also people.

Last week I visited people—people working, and learning, and exploring at a site called Metro Tech in Brooklyn, NY. I saw work being done on environmental technology, manufacturing technology, and telecommunications advances; work that exemplifies the goals of this legislation and the President's economic plan.

During my visit I used advanced software. Advanced software that was designed in accordance with standards established by the Department of Commerce. Standards established to analyze global environmental conditions using data collected by the Department of Commerce.

I talked to a student who happened to be an Air Force veteran who was developing software to improve microchip design, and who saw technology as means of building a career for himself in the 21st century.

I met a professor who handed me a 2-by-4, not to hit me with but to show me what new technology could provide. The 2-by-4 was made entirely out of recycled plastics. It looked just like wood. It was about the same weight as wood; had the same basic characteristics. He told me of his hope that new technology could further environmental goals through international cooperation and trade.

And then I had the opportunity to visit a day care center, which was part of this same complex, and I saw a young child who looked to be about 5 years old or so, oblivious to visitors, working intently on a program that was there to teach about life in foreign countries. Young people working with, learning from, and exploring the boundaries of technologies are, indeed, our Nation's future.

The choices that we make today will determine whether our young people will be prepared for the global marketplace. Our businesses must be prepared to compete and win against international competition. And the Department of Commerce and this administration are absolutely committed to assuring those victories.

We must tap the stream of new technologies to create world class products and services. Our infrastructure must be modernized. Our workforce must have new skills. The President's economic plan, using strategies outlined in S. 4 and its predecessors, I believe, will achieve these goals.

As we sat in the White House with the President to create this plan, one thought was always made clear. We face now an opportunity that we cannot afford to miss; an opportunity to put America back on the right track; an opportunity to ensure our economic growth.

That effort will begin in the stimulus package because the President wisely understands that stimulus must be the leading edge of our long-term economic strategy. That is why the stimulus proposal includes additional funding for the Advanced Technology Program and for the information superhighway.

The stimulus program will begin the long-distance run toward increased competitiveness, but at a sprinter's pace. And then, to extend the analogy, the baton will be passed to the investment program, and to the use of technology policy to create jobs, ensure long-term growth, and improve Government services. We, in fact, want to make Government user-friendly for a change.

Indeed, the investment program includes a tripling of NIST's budget, a dramatic increase in the ATP program, the creation of more than 100 manufacturing extension centers nationwide by 1997, and seed money to jump start the development of information superhighways.

In my view, all of these goals are reflected in S. 4, and I would like to commend you, Mr. Chairman, and the committee for fashioning a measure the truly looks to the future and sets us on a course for the 21st century.

And this is no surprise, because the work of this committee has been instrumental in the formation of the Clinton administration's view of manufacturing and technology policy. President Clinton's call during the campaign for the creation of more manufacturing centers drew from your past work and the early success of those places, which are now known around the country as the Hollings Centers.

The Vice President served as a member of this committee, where he worked on the original proposals for information superhighways, and the early introduction of S. 4 signaled your commitment, which we are pleased to share, that manufacturing and technology must be at the forefront of our political agenda.

The Clinton administration believes that S. 4 is an important step toward assuring American competitiveness. Specifically, we strongly support the principles of title II of S. 4. The 21st century manufacturing infrastructure program will allow the Department of Commerce to develop a one-stop shopping network for smaller manufacturers.

Our present extension services will be improved and better coordinated. This integrative program will help many more of the Nation's 350,000 small and medium size manufacturers become aware of the benefits of applying advanced manufacturing to their own businesses.

We also strongly support substantially increased funding for the Advanced Technology Program as set forth in the President's economic proposals. ATP is clearly working. Although it is a young program, there are already 60 ATP projects underway with support provided through a wide variety of different critical technologies including biotechnology, machine tools, and advanced materials.

ATP is a superb concept based on three fundamental and tested principles. First, the projects must be suggested by industry, not by Government employees. Second, projects must be subjected to a competitive selection process that assesses both the technical and business aspects of the proposal. Industry has to put up matching funds, and each project has to have a definite end. Third, the projects have to relate to emerging generic technologies that have potential applications for a broad range of products and processes.

We also support the new technology monitoring or benchmarking provisions in section 314 calling for the collection and dissemination of information that will help industry and Federal policymakers assess the relative strength of U.S. versus foreign capabilities. I would like to work with the committee to determine how best to manage that function.

I am also pleased that the bill contains provisions that will further the goal of bringing an advanced information superhighway system to all Americans. With the funding that I have already described, I would like to be the Secretary of Commerce, assuming we are successful in our goals, to help bring that system into being.

There are two sections, Mr. Chairman, on which I would like to reserve judgment pending further study and discussion. First, I would like to consult with other members of the administration about the American workforce quality partnerships. I agree that Commerce has a substantial stake in the quality of the workforce. We care, not just because of its importance to companies that are our constituents, but because Commerce also cares about American workers.

Secretary Reich, Education Secretary Riley, and I will begin intensive dialog to determine how best to mobilize and utilize a rejuvenated Labor-Education-Commerce team to meet this initiative. We want to move swiftly, and we want to move effectively. This legislation embodies the same goals.

Second, I would like to reserve judgment at this time on the loan and equity financing provisions of title III. I assure you that I fully appreciate the special capital formation problems of high-technology companies. As I indicated during my confirmation hearing, I took an early trip to Silicon Valley, met with a number of CEO's of high-technology companies, and they impressed upon me early on the importance of patient capital, and how crucial that is to really pursuing new technology both in the high technology and the biotechnology area.

But this portion of S. 4, unlike some of the others we have discussed, has not been subjected to intense administration consider-

ation. Given the importance of these financing provisions, I am sure that the committee will understand that I want to consult with other key agencies that have an interest in this matter.

Mr. Chairman, it is very much a new day at the Department of Commerce. I have been very, very pleased with the energy levels I have found with those who have served there for many years. They seem to be now more inspired than ever to meet the new challenges ahead.

I have enjoyed sharing with you this morning my outline of the new vision for the Department that incorporates technology, focuses on competitiveness, and seeks economic growth. I believe the early completion and swift passage of S. 4 will be an important step toward that goal.

Mr. Chairman and members of the committee, I would be pleased to respond to any questions that you might have.

[The prepared statement of Secretary Brown follows:]

PREPARED STATEMENT OF SECRETARY OF COMMERCE RONALD H. BROWN

Mr. Chairman, members of this Committee, I appreciate the opportunity to testify today on S. 4, the National Competitiveness Act of 1993. I want to discuss with you how this legislation, together with my vision of the Department of Commerce, will further President Clinton's agenda, promote economic growth and create jobs for our nation.

A week ago today, the President introduced to the American people his economic plan. The goals of that plan are obvious: to create jobs and to ensure long-term prosperity by quickly enacting a stimulus program, then investing in our future while, at the same time, we cut our massive budget deficits.

Mr. Chairman, I spent the two days after the President's address in New York and Chicago. What I found was not surprising. The American people want their government to work. They want the gridlock to be broken. They want this President to succeed. They want to reach the goals that this economic program is designed to achieve.

And they believe we can be successful. The American people don't believe that the best days are behind us, or that we are faced with inevitable decline. They have hope and the President's plan will reward that hope with, as his plan is appropriately titled, "A Vision of Change for America."

That vision includes—indeed, it is the same—as the vision of S. 4. The President's plan will make the Department of Commerce a focal point for civilian technology. We will help to forge a national economic strategy through the close cooperation of business and government.

We will do so by drawing upon the insights of S.4 and earlier legislative efforts to ensure that economic growth in America is powered by the engine of technological progress. We will do so by creating an extraordinary public/private partnership that will couple governmental assistance with the vigor of the marketplace. Where private mechanisms falter, the government should work to help remedy market deficiencies so that America's businesses will have an equal chance to succeed in the global marketplace.

Technology is more than machines and markets. It's also people.

Last week I visited people working, learning and exploring at Metro Tech, a technology center in Brooklyn, New York. Located there is the Brooklyn Polytechnic University where I saw work being done on environmental technology, manufacturing technology and telecommunications advances—work that exemplifies the goals of this legislation and the President's economic plan.

During my visit, I used advanced software—designed in accordance with standards established by the Department of Commerce—to analyze global environmental conditions—data collected by the Department of Commerce.

I talked to a student—an Air Force veteran—who was developing software to improve microchip design—and who saw technology as his means of building a career for himself in the Twenty-First Century.

I met a professor who handed me a two-by-four—made entirely out of recycled plastics. He told me of his hope that new technology could further environmental goals through international cooperation and trade.

And then, at an associated facility, I visited a day-care center. Sitting in front of a computer there was a young child, oblivious to visitors, working intently on a program that taught him about life in foreign countries.

The connection is obvious. Young people—working with, learning from and exploring the boundaries of technology are America's future. So, too, are the farsighted businesses that see a future filled with opportunity—not just paved with pitfalls.

Mr. Chairman, the choices that we make today will determine whether our young people will be prepared for the global marketplace. Our businesses must be prepared to compete—and win—against international competition. We must tap the stream of new technologies to create worldclass products and services. Our infrastructure must be modernized. Our workforce must have new skills.

The President's economic plan—using strategies outlined in S. 4 and its predecessors—will achieve these goals. As we sat in the White House and worked with the President to create his plan, one thought was always made clear—we face now an opportunity that we cannot afford to miss; an opportunity to put America on the right track again.

That effort will begin in the stimulus package. It is critical that we create jobs and ensure that the economy does not again lapse into recession.

But the President wisely understands that stimulus must be, as well, the leading edge of his long-term economic strategy. That is why the stimulus proposal includes:

- \$103 million in additional funding for the Advanced Technology Program,
- \$14 million so that the National Institute of Standards and Technology (NIST) can begin work now with other Federal agencies on the next phase of our plan to help build information superhighways by focusing on information infrastructure and manufacturing applications.
- \$64 million for the National Telecommunications and Information Administration (NTIA) to start the third phase of the information superhighways program by supporting the establishment of information networks among universities, school systems, libraries, health care facilities, and other providers of community services,
- \$81 million for the National Oceanic and Atmospheric Administration (NOAA) to speed-up its progress on weather service modernization—a program that will enhance public safety and economic competitiveness.

These programs will begin the long-distance run towards increased competitiveness—but at a sprinter's pace.

And then—to extend the analogy—the baton will be passed to the President's investment program.

The President and the Vice-President have spoken, often and at length, about the importance of technology policy. They recognize that a strategy for international competitiveness must transcend economic policy, trade policy and domestic policy.

Our success today—and the future we leave for our children—cannot rely on the status quo, piece-meal approach of the past. Our nation's preeminence in manufacturing demands an integrated approach: One that addresses the continuum from R&D through manufacturing into the marketplace; one that appreciates that the tangible problem facing American industry today includes financing, business practices, intellectual property protection, and fair trade.

But technology is also the key. And the President's technology policy, released on Monday, demonstrates in a myriad ways how technology can be used to create jobs, ensure long-term growth and improve government.

Of course, just inventing new technology and investing in R&D is not enough. Our economic future depends on the ability of business to move technology rapidly from the laboratory to the marketplace. It depends on using technology to re-vitalize our manufacturing sector. It depends, in my judgment, on a strong and effective Department of Commerce.

The President's investment package will give us the support that we need. It includes:

- a tripling of NIST's budget—from under \$400 million now to about \$1.4 billion in 1997,
- a dramatic increase in the ATP program, including increased funding of at least \$130 million in FY 94, rising to a program level of about \$750 million in 1997,
- increased support for consortia similar to the model used for SEMATECH,
- a program to create more than 100 manufacturing extension centers nationwide by 1997,
- a doubling of the R&D work carried out by NIST labs over the next four years,
- seed money to jumpstart the development of information highways.

Financial support is, of course, the predicate. But it alone will not be sufficient. The third part of the President's economic plan calls for a dramatic reduction in the federal budget deficit. In Fiscal Year 1997 alone, for example, we will cut the deficit by \$140 billion, from \$346 billion to \$206 billion. Deficit reduction of that size will

help private investment of all kinds but, we can hope, will particularly help new companies or businesses that are willing to take a chance on technological innovation.

And we will do more. Government has the duty to create an environment in which industry can bring new technology to market and compete effectively. And we have the responsibility to understand and articulate how economic change will affect our lives, our industries, and our complex web of relationships. From this crucial vantage we can be leaders. We can build effective partnerships—partnerships that solve real problems faced by industry and identify impediments and create incentives toward economic growth. It is my view that governmental support for industry must, as closely as possible, replicate the advantages of the private marketplace. To do that, we must be in a continuing dialogue with business. We must make government user-friendly.

Mr. Chairman, this Committee will soon have the opportunity to consider and—I expect—confirm the nomination of John Rollwagen to be my Deputy Secretary. I chose him because he is both a businessman and a visionary. He will help me explain to business what we intend to achieve—and listen carefully to the private sector's advice.

More than that, I want to set an example. My vision of the Department of Commerce depends on changing the way we do business. If we are to lead, we must demonstrate it with our actions.

Last week, I opened the "Quest for Excellence V" Conference, where the 1992 recipients of the Malcolm Baldrige National Quality Award winners gathered for a concentrated program of quality management. I want to reaffirm to you today a commitment I made to those gathered last week: I intend to bring to the Department of Commerce the same quality criteria that is the basis for winning the Baldrige Award.

That means a commitment to leadership and a focus on customer-driven quality that will provide a fast response and continuous improvement in our operations and programs. It means—it will allow—the successful implementation of the President's economic program.

Before I discuss the provisions of S. 4 specifically, I would like to commend the Chairman and this Committee for fashioning a measure that truly looks to the future and sets us on a course for the Twenty-First century. This legislation, like the President's program, shared a concern for making full use of our intellectual capital, effective use of new manufacturing technology, new management strategies, and redefined governmental responsibilities.

This is no surprise, because the work of this Committee has been instrumental in the formation of this Administration's view of manufacturing and technology policy. President Clinton's call during the campaign for the creation of more manufacturing centers drew from your past work—and the early success of those places aptly known as "Hollings" centers. The Vice-President served as a member of this Committee, where he worked on the original proposals for information super-highways. And the early introduction of S. 4 signalled your commitment—which we are pleased to share—that manufacturing and technology must be at the forefront of our political agenda.

Today, I would like to review, in general terms, the provisions of S. 4. As I am sure you can appreciate, Mr. Chairman, we would like to continue to consult with you about some details of the program, but, at the outset, it is clear that we are speaking the same language.

First, we strongly support the principles of Title II of this bill. We absolutely agree that within ten years the United States should be second to no other nation in the development, deployment and use of advanced technology. The Twenty-first Century Manufacturing Infrastructure Program will allow the Department of Commerce to develop a "one-stop shopping" network for smaller manufacturers. Our present extension services will be improved and better coordinated.

This integrated program will help many more of the nation's 350,000 small and medium-sized manufacturers become aware of the benefits of applying advanced manufacturing to their own businesses, teach them how to choose and apply advanced manufacturing technologies and practices best suited to their individual needs, and help them learn how to make and implement decisions right on the factory floor.

Mr. Chairman, it is not just a question of making sure that small business has access to the most advanced manufacturing technology. Many smaller businesses need help in finding out about easy-to-use, technological solutions to their problems. They need to be educated about how to identify problems, and access technological alternatives. The legislation we are considering can help us attack that problem.

We also strongly support substantially increased funding for the Advanced Technology Program, as set forth in the President's economic program. ATP is clearly working. Although it is a young program, there are already sixty ATP projects underway, with support provided to a wide variety of different critical technologies, including biotechnology, machine tools, and advanced materials.

ATP is a superb concept based on three fundamental and tested principles: First, projects must be suggested by industry, not government employees. Second, projects must be subject to a competitive selection process that assesses both the technical and business aspects of the proposal. Industry has to put up matching funds and each project has to have a definite end. Third, the projects have to relate to emerging generic technologies that have potential applications for a broad range of products or processes.

We also support the new technology monitoring or "benchmarking" provisions in Section 314 calling for the collection and dissemination of information that will help industry and federal policymakers assess the relative strength of U.S. versus foreign capabilities.

However, I want to give further thought as to how to best implement the concept—that is, whether to create a new office as the bill would do or to draw upon and strengthen existing capabilities—such as the information dissemination capability of the National Technical Information Service and the analytic and policy formulation capability of the Technology Administration.

Of course, information based on relative R&D strength gives federal and business policymakers only a piece of what they need for informed decision making. The primary goal for policymakers is to assess the performance of U.S. industry in international competition.

Thus, information about relative strength is only the starting point. I believe that the Department of Commerce can also house programs that provide objective analysis about these issues and develop appropriate programs for ensuring that we are the main beneficiaries of our own innovative strength. Your bill provides an excellent starting point.

S. 4 would establish new advisory bodies, including a Commerce Technical Advisory Board. As I have said already, close consultation with industry is crucial, but the creation of new advisory bodies may not be necessary. The President has instructed each Department to reduce the number of advisory commissions and to consider carefully the kind of advisory commissions that are created. Thus, we have reservations about the overuse of advisory bodies.

I am also pleased that the bill contains provisions that will further the goal of bringing an advanced information superhighway system to all Americans. With the funding that I have already described, I would like to be remembered as the Secretary of Commerce who helped to bring that system into being.

I would note, however, that S. 4 requires the involvement of many federal agencies whose activities will have to be carefully coordinated. Accordingly, I wish to consult with them to ensure that their views and concerns are addressed before endorsing any specific language.

There are two sections, Mr. Chairman, on which I would like to reserve judgment pending further study. I ask the Committee to reserve judgment too, pending further Administration review.

First, I would like to consult other members of the Administration about the American Workforce Quality Partnerships. I agree that Commerce has a substantial stake in the quality of the workforce. We care not just because of its importance for the companies that are our constituents, but because Commerce "puts people first" too.

A consensus now exists regarding the need to upgrade workers' skills and help our workforce make the difficult transition to the demands of a flexible, high-skills workplace. Unlike Germany, the United States does not have a sophisticated vocational education program. And unlike Japan, U.S. firms do not have a strong incentive to invest in the training and retraining of their workers. Our nation's future economic strength depends on more effective training programs and greater incentives to invest, geared to meet the needs of the mobile U.S. workforce.

Labor Secretary Reich, Education Secretary Riley and I will begin an intensive dialogue to determine how best to mobilize and utilize a rejuvenated Labor-Education-Commerce team to meet this initiative. We want to move swiftly, and we want to move effectively.

Section 216 of this legislation embodies the same goals. Accordingly, I would like to work with Secretary Reich and Secretary Riley to determine how to make the most meaningful contribution to improving workforce quality and how this would complement existing programs. I hope to provide you with some recommendations shortly.

Second, I would like to reserve judgment at this time on the loan and equity financing provisions in Title III. assure you that I fully appreciate the special capital formation problems of companies that often consist of little more than "three people and an idea" as compared with those with more traditional brick and mortar assets. As the technology policy, released on Monday, states, the Administration will carefully study how to improve the environment for long-term investments.

Indeed, the economic program contains a number of ways to promote improved capital formation. First and foremost, of course, is the reduction of the budget deficit, which will drive down long-term interest rates and boost business expansion. Specific tax provisions, like the investment tax credits, the permanent research and experimentation tax credit and the incentive for investment in small businesses will also provide particular assistance to the high-tech sector.

That does not mean, of course, that more cannot be done. But this portion of S.4, unlike some of the others we have discussed here today, has not been the subject of intense Administration consideration. Accordingly, it was not included in the President's economic plan or his recently released technology policy. I know a lot of work has gone into this proposal, so I would like it to receive the study it deserves. Given the importance of these financing provisions, I am sure you understand that I will want to consult with other key agencies that have an interest in this matter.

The Department will continue to consult with the Committee on the provisions that require further study and any others that may prove to be problematic. We will seek to provide detailed views in time for the Committee's markup of the bill.

Mr. Chairman, we are in the fifth week of Bill Clinton's presidency and already it is very much a New Day at the Department of Commerce. I have enjoyed sharing with you this morning my outline of a new vision that incorporates technology, focuses on competitiveness, and seeks economic growth. Much of the outline remains to be filled in, and we know already that it means a more strategic and innovative use of resources, personnel and facilities within the Department of Commerce. I believe that early completion of S. 4, and its swift passage, will be an important first step towards that goal.

Thank you, Mr. Chairman, for your patience and your attention. I will be pleased to answer any questions you may have.

The CHAIRMAN. Very good, Mr. Secretary. Did you have any questions?

Senator DANFORTH. I have to leave.

The CHAIRMAN. I understand our colleague, Senator Burns, had a statement he wished to make.

OPENING STATEMENT OF SENATOR BURNS

Senator BURNS. Thank you, Mr. Chairman, and I do, and I just ask unanimous consent that it be entered in the record.

But just to summarize some of the things that I see coming from this piece of legislation, I want to congratulate the chairman for moving S. 4 this early in the session so that we do have time to really look at this piece of legislation and its effect on this country, and especially in our position of being able to compete in a global economy.

By the way, Mr. Chairman, you may add me as a cosponsor to this legislation. I think I am the first one on this side of the aisle to do so. I am supportive of title VI and how that applies to all of Americans when we start talking about moving new technologies into areas across the country rather than just in concentrated areas. And I want to see it really work.

I want to congratulate Secretary Brown for him coming forward this morning and giving his views on this piece of legislation, particularly his views on the electronic highways because I think they are key to the infrastructure of the future that all Americans get to participate in this technology explosion, so to speak, that is happening across the country, and how that plays into the way we edu-

cate our kids, the way we handle rural health, rural education, and, of course, our infrastructure in our rural States to promote economic opportunity and equality among our rural areas to compete in the marketplace.

It is true that the cold war is over, but we still have another battle, and that is in this world economy to compete with the rest of the world. We have just about given all of our manufacturing sectors away to a foreign competitor with the exception of the pharmaceuticals. That is about the only place that we are really No. 1 in the world—the development and the marketing of pharmaceuticals around the world.

I think we could probably take a lesson out of their page on how to stay competitive, but, nonetheless, what this does, this piece of legislation, is move us forward in an area which I think will be the infrastructure of the future, that we will just have to be able to compete in this area, rather than develop new products, new ideas in this country, and then have those new products and ideas move offshore and we have to buy them back.

That day has got to stop.

And so I congratulate the Secretary. I congratulate the administration. And I congratulate our chairman for moving this piece. I do have some problems with some parts of it. But there is no perfect piece of legislation, and I think we can work together on those areas where we need to do that.

Thank you, Mr. Chairman.

And I will just ask that my full statement be entered into the record.

The CHAIRMAN. It will be included.

[The prepared statement of Senator Burns follows:]

PREPARED STATEMENT OF SENATOR BURNS

Mr. Chairman, let me first of all congratulate you for your demonstrated leadership on high-tech issues with the introduction of this forward-looking bill, S. 4, the National Competitiveness Act. Mr. Chairman, I do have some concerns with this legislation before us today—but, overall, and on balance, this is the appropriate direction for our government to be going in the critically important area of high technology.

As a result, Mr. Chairman, I want to add my name as a cosponsor of your legislation—and I believe by doing so I am the first Republican to do so. I want you to know that I welcome your leadership and look forward to working closely with you in moving this legislation and other bills on high-tech and telecommunications forward in the 103rd Congress.

Mr. Chairman, let me welcome Secretary Brown to our Committee. Secretary Brown, during your confirmation hearing I was very impressed by your views on the importance of the Commerce Department playing a proactive role in the planning and implementation of a national technology policy and, in particular, the building of an “electronic superhighway”. I am looking forward to hearing your views on S. 4, which, I believe, marks an important first step in the formulation of such a policy.

Mr. Chairman, we are at a pivotal juncture in our history. The Cold War is over and the battlefield has shifted to the global marketplace. Military tensions with China and Russia have given way to battles for market share with Japan, Western Europe and other nations in such high-tech industries as semiconductors, computers, communications, aerospace, and biotechnology. While the U.S. enjoys a leadership position in many of these areas, we have seen alarming signs of slippage. A recent GAO report indicated that U.S. businesses have lost market share to other countries in all but one of eleven high-tech industries. Only in pharmaceuticals did we retain our market share.

Mr. Chairman, we must reverse this trend. To do so, we need a comprehensive technology policy that addresses the full range of issues facing today's businesses.

As I already indicated, S. 4 appears to me a responsible first step toward the development of such a policy.

Most significantly, in S. 4, Mr. Chairman—and the area I am, of course, most extremely excited about—is Title VI of the bill. Title VI includes the language of S. 2937, which I cosponsored with Vice President Gore last year.

We are on the verge of digital, multimedia, technological revolution. It is arguable that computing and communications technologies are the most critical enabling technologies being looked at today. Title VI calls for a multiagency program to develop promising computer applications in education, health, manufacturing, and other key areas. This program will support a vibrant information infrastructure that will invigorate our technology base, improve our global competitiveness, and strengthen our scientific literacy. It is an idea whose time has come.

Let me note, however, a word of caution. At the same time we are moving forward funding programs to assist in information infrastructure modernization, we, as policy makers, must also develop a legal and regulatory framework for increased private sector investment—a framework which promotes fair competition, encourages innovation, allows for the involvement of all participants and industry segments, and insures universal access to all Americans. Moreover, this policy framework must also clearly delineate government's role from the private sector, commercial role.

By doing so, Mr. Chairman, we can ensure that the information infrastructure reaches its full potential—including better education for all children, better health care services, job creation and strengthened U.S. competitiveness.

S. 4 also authorizes significant enhancements of NIST's programs to assist small- and medium-sized business modernize and improve their operations. At the center of these activities are NIST's Hollings Centers, which, in their few years of existence, are seen as models for how government can provide useful technical support to small businesses. These kinds of programs are critical because it is the small companies around this Nation that actually create most of our jobs. The federal government must do a better job in sharing its technical expertise, particularly in regard to manufacturing processes, with small private firms who lack the time and resources to hire efficiency or quality control experts.

Mr. Chairman, during the past few years, there have been persistent calls for a civilian version of DARPA, the defense R&D agency that has produced so many commercial spinoffs in recent times. Mr. Chairman, I would submit that we already have a Civilian DARPA and it resides right here at DOC's National Institute of Standards and Technology (NIST). I am very confident that, under Secretary Brown's strong leadership, NIST will fulfill those expectations. In that regard, I note that S. 4 provides increased authorization for the Advanced Technology Program (ATP), which provides multiyear grants to high-firms to conduct generic, precompetitive research (that is, that research leading up to the development of commercial prototypes).

Again, thank you, Mr. Chairman for holding this hearing and for demonstrating continued leadership and vision in the area of technology policy.

The CHAIRMAN. Senator Gorton.

Senator GORTON. No statement.

The CHAIRMAN. Senator Bryan.

Senator BRYAN. Mr. Chairman, I will defer making an opening statement, but would ask unanimous consent that the prepared text of my opening statement be made a part of these committee proceedings.

The CHAIRMAN. Very good. It will be included.

[The prepared statement of Senator Bryan follows:]

PREPARED STATEMENT OF SENATOR BRYAN

Mr. Chairman, thank you for holding this hearing, and for being such a strong advocate of the legislation we are considering today.

I am pleased to be a cosponsor of this legislation, and especially pleased that we finally have an Administration witness who strongly supports the bill. President Clinton is clearly on the right track in identifying the programs contained in this legislation as priorities for his economic development plan.

Secretary Brown, I will not repeat the many obvious advantages of this legislation. I am certain that you are well aware of the many opportunities this bill will create for American businesses, and the accompanying increase in the number of

good quality jobs that these new opportunities will create. In addition, I am certain that you will agree that this legislation is an important step in regaining America's status as the undisputed world leader in industry, technology, and quality manufacturing.

There are a two concerns, however, that I would like to mention today due to their importance to the State of Nevada.

First, I would like to emphasize the importance of this legislation, and other facets of President Clinton's program, in the continuing effort of defense conversion. In Nevada, we have one of the most important facilities which helped enable America to win the cold war—the Nevada Test Site. Over the years, the highly trained workers at the Test Site have provided an important service to our nation. I can count many personal friends among the workers at the Test Site—in fact, I worked at the Test Site a number of years ago.

Today, the future operation of the Test Site is in question. While the US Government will without doubt need to maintain some sort of nuclear testing capacity, a large number of the nearly ten thousand workers at the Test Site will likely, at some point, need to find other employment.

As you continue to develop the Administration's technology policy, the powerful potential human resources at the Nevada Test Site should be factored into you plans. We should turn this Cold War facility to new missions to help America compete in the global marketplace.

I am confident that both you, Secretary Brown, and President Clinton are sensitive to this concern, and I hope that you will give very strong consideration to any potential use of the programs we will establish with the legislation before us today to aid in the effort towards defense conversion, particularly as it relates to the Nevada Test Site.

I would also like to emphasize that the need for the type of manufacturing programs included in this bill, particularly the manufacturing extension centers, exists across the nation, and not just in areas that already have a very high density of manufacturing firms.

In Nevada, our economy has traditionally been based largely on the service industry, particularly travel and tourism. In recent years, however, there has been significant growth in the manufacturing sector, particularly by small businesses. While at this point Nevada does not have a state sponsored technology extension program, it does offer a very attractive business environment for manufacturing businesses, and the state continues to attract more and more manufacturing.

Nevada is the fastest growing state in the nation, and Nevada residents need the type of good, high paying jobs that can result from modern, efficient manufacturing. I am hopeful that the programs that result from this legislation will provide suitable support for investment for areas with relatively low current levels of manufacturing, but great potential such as Nevada.

Mr. Chairman, thank you again for holding this hearing. look forward to hearing the testimony of Secretary Brown.

The CHAIRMAN. Mr. Secretary, yesterday, the distinguished president of Ford Motor, Harold "Red" Poling, addressed the National Press Club, and in a line I think he said that we have been exporting free trade and they have been exporting cars. He brought it right into focus with respect, for example, to dumping.

Now, there has been an affirmative action plan that continues right up to the moment to ignore and frustrate the dumping laws. In fact, the laws themselves are totally inadequate when it comes to being a business. You go up first before the International Trade Administration to get a preliminary finding in your Department of Commerce.

Then you go to the International Trade Commission and you get a preliminary confirmation of that finding. Then, after two preliminaries, you go back in for a second go around in an adversary proceeding that takes 18 months to 2 years, whereas in Europe, our competition, it is a direct as to whether or not a violation has occurred, just like you were speeding, whether or not there is dumping. And you make a finding in less than 9 months.

That is one thing.

The other thing, of course, is the tremendous cost. I know colleagues in the textile industry who make manmade fiber sweaters and have been in there 2 years, already spent \$2 million, have won at every stage. They are now at another appeals process. But you have to ask yourself: "Is it worth the financial effort of the industry?" Then, the industry itself says, "Wait a minute, not just the financial end of it. We do not want to be losing business or be presumed to be protectionist or anticonsumer."

This was Texas Instruments back in 1985 on semiconductors. And as a result, they came to your Department and got Secretary Baldrige to institute the dumping case itself.

Now, with respect to GM, Chrysler, and Ford, they were all prepared to file a dumping violation case, and while I have not gotten the truth yet, I understand that they may have gotten support from you. They may have gotten opposition from Mr. Kanter and Secretary Christopher or others. I am not sure.

Be that as it may, we have got to really have the law and have the policy. You are making glowing statements, you are right on time about businesses being competitive. What is not been competitive is you and me—the Government. We have got the most competitive industrial worker in the world. We have got the most uncompetitive Government. The whole sing-song for the past 12 years was get rid of the Government.

Now, getting right to the point, what about the Department of Commerce initiating a dumping case for the automobile industry here in America?

Secretary BROWN. Well, we certainly have the authority to do that, Mr. Chairman. I feel as strongly as you do about the necessity for us enforcing our antidumping laws. I made that commitment to you and members of the committee during the confirmation process, and I will restate it again today. I think our laws have to be vigorously enforced, and I intend to be a Secretary of Commerce that sees that that is done.

I am meeting later this afternoon with the CEO's of the Big Three auto makers, Chrysler, Ford, and General Motors. We are going to be having some discussions. I followed with interest all of the speculation about whether an antidumping case would be filed. I really, though, think it would be inappropriate for me, before having a discussion with them, to indicate whether it would be our intention to initiate such a filing. That is unusual action, as you know, but I think there might be times in the future where we would take unusual action. We have not reached a conclusion on that, as yet, Mr. Chairman.

The CHAIRMAN. Well, that is the change. That is why you got elected. That is what you said, there is going to be change. Because we have got the information, to the effect, that for the 1993 model Toyota Lexus, there is a 14.7-percent dumping margin there; for a 1993 model Mazda Protege, there is a 21-percent dumping on that particular model Protege. On another Mazda Protege, there is a—I remember reading it earlier here—a dumping margin of 29 percent. Yes, the Protege 323 Familia, that is at 29 percent.

There is a Toyota Tercel with a 14-percent dumping margin. A Nissan Sentra, 23 percent. A Honda Civic, 19 percent. You can go right on down the list.

I had a friend recently price a Toyota Cressida at \$23,500 here in the States, and it is selling for \$31,500—an \$8,000 difference. This is really something, when Ford does have the No. 1 quality car and productivity, the No. 1 productive plant in automobile production is right down in Atlanta. We have got it right here in the United States.

So, we politicians have got to get off the golf course. You have got to quit going to these meetings. You have got to get competitive. It is us up here that have not been doing the job. And you say it is unusual—we want to make it usual if the Government puts it out that they are going to start enforcing their laws as in Europe. They have got over 30 percent, and then with the transplants in, they have got 35 to 36 percent, the foreigners have, of the U.S. automobile market. There is only 16 percent in the European Community.

And that is exactly what they do. They tell them, but I mean not just conversations, because I was in what they call the Roosevelt room now, with President Kennedy and with the Japanese Ambassador, and we were telling them then. That is 31 years ago, and you can see where we still are.

So, we can go through that sing-song, but unless the Department itself acts, we are going to really be just going through the same song and continuing to go out of business. And where two-thirds of the clothing in this room is imported now, in a few years, two-thirds of the automobiles, when they continue to dump in here and everything else like that. If I can get a Ford automobile at 20 percent less than cost, that is going to be a good deal.

So, that is pure and simple, the competition that we are facing, and it is global competition. And the only way to bring about free trade is on a competitive basis, and not on admonition, persuasion, and remember our special relationship, and all these pleadings, be fair, be fair. That is sick call. That is not going to get us anywhere. We have got to let market forces operate. And the Government, your Department, is an integral part of that market force, a very, very important part.

Let me yield as we go around, because I have got a whole series of questions on the trade as well as on S. 4 itself.

Senator Rockefeller.

Secretary BROWN. Mr. Chairman, could I just respond for a moment?

The CHAIRMAN. Yes, surely.

I certainly agree that we are not playing on a level playing field now. I think that this administration, the Commerce Department in particular, has an absolute obligation to make sure that we level the playing field. And clearly, enforcing our trade laws is one appropriate and proper way to do that.

The CHAIRMAN. Thank you.

Senator Rockefeller.

Senator ROCKEFELLER. Thank you, Mr. Chairman.

Secretary Brown, in your written testimony, when you refer to special capital formation problems, et cetera, then you use the words "carefully study." There are three things that are very important in commercialization of products, as the chairman clearly knows.

The Mineta amendment sort of becomes symbolic. The Bush administration threatened to veto the entire NIST authorization if there was \$10 million put in there for commercialization, not just, you know, precompetitive, but commercialization of product. So, we had to take it out so he would not veto the NIST thing.

Venture capital, you mention. You mentioned three people and an idea. And again, the words "carefully study" comes up on that. And then, when you are talking about—there is the question—I would like you to be stronger, and I know that you have not—you have been there just a very short time. I think capital formation, the venture capital consortium idea for critical technologies, which some of us were working on last year, is incredibly important. I think commercialization is incredibly important.

And I think that, even though they have not been carefully studied yet, that I would want to assume, No. 1, that there was a—that is simply a matter of time, that you are committed to doing this, that you recognize the full value of commercialization. And let me extend that one point further.

There is an emphasis a little bit on supporting precompetitive technologies, but the instinct that that may not be driving competitive technology. In other words, precompetitive as opposed to technology that could be taken to market. Which is, in a sense, like putting research into a better laser as opposed to research into the commercialization of a product using a better laser.

In your testimony, sort of the intensity about that commercialization, the venture capital risk money, the Mineta amendment-type thing, seems to me either left out or uses the words "carefully study."

Secretary BROWN. Senator, you know me as an individual of great intensity on issues and matters in which I believe deeply. Those that you raise are matters in which I believe deeply. The reason for the cautious language was, you are correct, we have not had an opportunity within the administration to consult, and I thought I had an obligation to consult with some of my colleagues about their position.

Let me assure you that, as I have indicated before, we are very bottom-line oriented. We are not interested in ideology. We are interested in results. We are interested in making us competitive as a Nation. We are interested in commercialization, not technology just for technology's sake. Although there is some merit, some would argue, in that. But, rather, technology that can be commercialized, thereby creating jobs for our people, and to be exported, creating additional economic growth opportunities.

So, we do have those commitments. The language that I used was only cautious or might have sounded cautious just because of lack of consultation thus far within the administration. I indicated earlier that I understand the capital formation problems. Clearly, I understand that they are key to growth and innovation in both high technology and biotechnology. And I understand fully we have got to do something about it, and not just talk about it.

So, my commitment remains strong on the issues of competitiveness. The precompetitive language I do not think was meant to say that we are not moving toward commercialization. That is the whole reason for the ATP program, the manufacturing centers pro-

gram, is to move toward commercialization, to get technology into a place and time where you can commercialize it.

So, that is our bottom-line goal.

Senator ROCKEFELLER. Great.

I have one more question for this round. On the Advanced Technology Product Awards to individual companies, under the current limits law or system, or whatever, that you can do without a 30-day notice and justification by the Secretary of Commerce to this committee, and then also to our House counterpart committee. It cannot be more than \$2 million over 3 years to an individual company, an ATP loan. And so there is a lot of, kind of, time going by there. Because R&D moves very quickly and technology moves very quickly.

My question, really, is in the ATP program. Are these limits potentially preventing NIST from supporting very, very good projects that significantly increase our technology base simply because there is a limit of a certain amount of dollars, and maybe that limit is an unnecessary one or an improper one?

Secretary BROWN. We would certainly, Senator Rockefeller, prefer more flexibility in this regard. As you know, that \$2 million figure makes no account for inflation. It is an arbitrary figure. So, we would be very pleased with having more flexibility so as not to prevent us from dealing with opportunities that might really be outstanding, but this limitation might keep us from doing it.

Senator ROCKEFELLER. I will stop for now.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you.

Senator Burns.

Senator BURNS. Thank you, Mr. Chairman.

Mr. Secretary, good morning to you, and welcome.

Secretary BROWN. Good morning, Senator Burns.

Senator BURNS. As you might know and understand, there is private sector building of telecommunications networks. It is coming from the cable companies, the telephone companies, cellular telephones, and alternative access groups, and this type of thing. And many contend that the proper role of the Federal Government is not to build a sort of superhighway in telecommunications that would compete with the ones that are going in now from the private sector.

Some would say that we should spend our Federal funds on research, user-friendly facilities, applications, training programs for teachers or instructors or the medical community, or, in other words, just how do we obtain this information that is on the highway?

Mr. Secretary, do you believe the Federal Government should own and operate telecommunications networks which compete with those established by the private sector?

Secretary BROWN. That is not our view, Senator Burns. We believe that all of this ought to be the principal role of the private sector. We do think there ought to be a Government-private sector partnership. That is what we think we are enunciating. That is what we think S. 4 helps us to do. We are committed to that kind of partnership where the Government is a helpful partner, but not the lead.

We have learned in the past that Government can be helpful. I think it is one of the reasons why we have moved the matters that you are very, very interested in, telecommunications superhighway matters, as quickly as we have, because Government has played a helpful role. I want Government to play a more helpful role, but not to be a competitor of private enterprise.

Senator BURNS. I notice you are pretty quick, too.

But I tell you, just like I said, most of my questions this morning will deal with that Title VI. But on the partnership, I think that that is kind of fuzzy right in there. Who do you think should manage and who do you think should operate that partnership-type of arrangement?

Secretary BROWN. I think, Senator Burns, it is fuzzy, because, as the chairman pointed out earlier, we have had a philosophy over the last many years which thought that any discussion about some kind of national economic strategy was abhorrent and we should not even be talking about it.

This is a change. We believe we should be talking about it. We believe that if we are going to be competitive in this increasingly complex global economy, we have to have Government and business working together as a team, with the private sector leading the way, but with our Government helping. And so I think that we are in transition. And I think some of it will probably be a little fuzzy for some time. And I think one of our responsibilities is to bring some clarity, but I want to be very straightforward.

This does mean that there is a change in thinking as to what the Government's role is in trying to be helpful to American business and industry to help them to be more competitive.

The CHAIRMAN. Would the Senator yield there?

Senator BURNS. Yes.

The CHAIRMAN. On that title VI, it is misleading, that information infrastructure. That word "infrastructure" should be changed to "research." We should just be in the research part of it. And this is very, very misleading. We are not going to be operating, as the distinguished secretary says. And as you are concerned about it, I am too. We are not going to put the Government in the operating area.

Senator BURNS. Those areas, just like I say, I want to be a part of this as it moves down, because there are areas where I think we could do a better job in defining where we are going.

In your trip to Silicon Valley you visited with John Sculley of Apple Computer and other leaders out there. And that computer industry released a proposal by a group called the Computer Systems Policy Project. Have you had time to review that, and do you have a position on the proposals they are making in that report?

Secretary BROWN. I do not have a specific position. I have had a chance to review it in a cursory way. I have met with the group that you mentioned and have established good relationships with a number of those CEO's, who I think could be very helpful to us in forging this partnership.

But I do not have a specific position on the proposal.

Senator BURNS. Mr. Secretary, some have suggested the Federal Government should lift some legal and regulatory barriers and restrictions, such as the cable-Telco cross-ownership restrictions and

restrictions on local telephone exchange competition, which prevent the full deployment and utilization of the Nation's information infrastructure.

Do you believe that the time has come to lift or substantially alter these and others restrictions as a way of spurring infrastructure modernization in the private sector?

Secretary BROWN. I think we need to have a review of a lot of our past policies. I do not want to make a specific comment on those that you refer to in your question, Senator Burns. But I think it is time for a broad review. If we are talking about creating economic renewal and growth, if we are talking about being competitive, if we are talking about forging new partnerships, I think this is an appropriate time for review of many things that we have done in the past that have not served us well.

Senator BURNS. I have a couple of other questions, and if I might just write to you and if you could respond to those, please.

Secretary BROWN. Sure.

Senator BURNS. I have got another committee meeting in appropriations. We are doing ledgework today. How much do you want to spend on this committee? [Laughter.]

Secretary BROWN. That is very important, Senator.

Senator BURNS. So, we will have to talk about that. I want to thank you.

The CHAIRMAN. With you there, that will be an economy move.

Senator BURNS. Yes. Well, we are trying to be sort of economists over there, but we are having some problems in some areas. But we will try our best.

I thank the Secretary for coming this morning and his patience.

Secretary BROWN. Thank you, Senator.

Senator BURNS. And I thank you, Mr. Chairman.

The CHAIRMAN. Very good.

Senator Bryan.

Senator BRYAN. Thank you very much, Mr. Chairman.

Let me compliment you for convening this hearing.

And, Mr. Secretary, having sat on this committee for 4 previous years, may I tell you how very pleased I am as to your approach and the administration's approach in forging what I think is an appropriate, and you make reference to it in your prepared text, a public-private partnership.

Those of us who have had some experience in a previous life at the State level have worked with the business community in public-private partnerships, I think, ultimately to the public good and to the benefit of the business community as well. And I am pleased to see the approach that you have taken.

You have mentioned several things, and I would like to try to get just a little more specificity, if you can help me out. I am interested in this concept of these manufacturing technology centers and the proposal to expand them. And I guess my question is: How is it to be determined who is eligible to get one of these manufacturing technology centers? I am speaking from my own perspective. We would be very interested in Nevada, and I suspect that my colleagues from other States would be interested as well.

What are the criteria, and I would be particularly interested in hearing your response to, can States that have relatively small

manufacturing bases, are they eligible for consideration, as well as those States which have traditionally had more extensive manufacturing undertakings?

Secretary BROWN. Senator, they certainly are. We fully understand how important it is to bring these opportunities to small rural areas, as well as urban areas. And I think one of the reasons we are so pleased with the President's economic plan and with the direction of S. 4 is that it contemplates significant expansion in the number of manufacturing technology centers.

When we get that kind of expansion, you can be assured that rural areas will be able to get the kind of consideration they deserve, as far as placement of those centers is concerned. We want to get them spread around the country. We want small communities and large communities to have access to them.

It was very difficult when we were dealing with the number of 7, but when we get to numbers like 100, I think we can be much more effective in increasing our outreach.

Senator BRYAN. Recognizing it will take you some time to develop, I am sure, the criteria, what kind of time line do you have in mind, in terms of providing the kind of information that States and communities might have the benefit of, in terms of preparing their applications?

Secretary BROWN. We are moving very rapidly in that regard, Senator Bryan. As you know, the stimulus package included the ATP. So, we are talking about very quick turnaround. We are gearing up our agency to make sure we can get information out quickly, so that we can get the process started.

Senator BRYAN. You mention in your testimony the SEMATECH, which I think is one of the great success stories, and that you would like to put together additional consortia like that. Do you have anything specifically in mind at this point? Is there a step 2, 3, 4, 5, beyond the SEMATECH?

Secretary BROWN. Well, as you know, Senator, people who have reviewed it have been very impressed with what SEMATECH has done, and we just want to replicate that. I do not know that we have a specific thing on the drawing board, but we certainly have had a lot of demand for wider and broader use of consortia. So, it is something that we will be pursuing in the weeks ahead.

Senator BRYAN. With respect to these advanced technology programs, who is going to be making the determination as to which of these programs is approved, recognizing that no matter what the level of appropriation, there are, I am sure, going to be more requests than you have money to fund? Explain to me, if you will, how you contemplate that that will work, in terms of how the determination is going to be made. Is there a committee that is going to be within the Department? What is the criteria for how much private, how much public sector?

You correctly point out that this ought not to be solely a Government-driven program. Clearly, industry has got to be involved. And it is just not clear to me what you may have in mind in terms of implementing that.

Secretary BROWN. Yes, Senator.

Well, first, your characterization is right about our attitudes. This has to be industry-driven. It has to be from the private sector,

initiated by the private sector. I think most who have evaluated the ATP program feel that it might be the best thing in the Government-private partnership that we have been discussing as far as its implementation is concerned.

It is a peer-review process. It is handled through NIST, our National Institute of Standards and Technology. I think they have done an outstanding job. We need to make sure that they are geared up for an expanded program. I believe that they are.

But I think peer review is the most important thing. That there be objective criteria, and that no one can believe or charge that there was some kind of political or other favoritism. But that it really be based on the merit of the program and the kind of impact it can have on technology and its commercialization.

Senator BRYAN. At this point, do you have any thinking in terms of what the public-private share ought to be? Is it a 50-50, 60-40, or 70-30 split?

Secretary BROWN. We strive for 50-50. You know, obviously, we would like it to be as much private as possible and as little Government as possible. We need enough Government resource in there to, in effect, provide some incentive and to get things done that would not ordinarily be done without some Government involvement. And I might add that the reviewers, the peer reviewers, are drawn from the business and industry community, not from the governmental community. So, it is true peer review.

Senator BRYAN. Mr. Secretary, I am sure you have probably had a chance to see this among all of the other information that has been provided to you during the course of your briefing, prior to the confirmation process and your ongoing review, but I was impressed but terribly disturbed to see a review of the critical technologies in America, looking where we were as a country in 1970, and to see, almost across the board, a decline in terms of our competitiveness in these critical technologies, that sort of thing which is absolutely essential for a highly industrialized and technology-oriented society to succeed in that international marketplace.

And I would certainly hope that as you look at some of these advanced technology programs, there might be some type of priority, in terms of, you know, there is not going to be enough for everybody to get all that they like, and we understand that in Government. You are going to have to make some judgments with your peer review. But if you look at those critical technologies, if we are not successful in competing in those areas, there is not great optimism that we are going to be a world-class competitor in those areas in the future.

Secretary BROWN. Well, we have a real responsibility, Senator, that is, the administration, working with this committee and the Congress, to reverse that trend. That is what this administration is committed to doing. I hope that we have indicated that clearly, not only through my testimony today, but in every statement that has been made about competitiveness and trade and technology.

We understand the gravity of the problem. We understand how the trend lines look, and we have to intervene in such ways as to reverse those trend lines.

Senator BRYAN. Thank you very much, Mr. Chairman.

And, Mr. Secretary, we look forward to working with you.

Secretary BROWN. Thank you, Senator.

The CHAIRMAN. Senator Pressler.

Senator PRESSLER. Thank you very much, Mr. Chairman.

And let me congratulate you on taking this initiative. I think it is something we need to do in one form or another.

Mr. Secretary, I was going to say Mr. Chairman, Mr. Secretary, we thank you very much for your leadership in this area.

Let me ask you about title III critical technologies if I can, one part of it. I serve as ranking member on the Small Business Committee, and am concerned about getting more capital to small businessmen through one form or another. But we have the SBIC program for small business loans.

It seems to me that subtitle (b) stimulating investment, will authorize some experimental programs to stimulate the flow of investment capital technology firms, a small DOC loan program, a pilot program to assist venture capital firms, modeled on the proven Small Business Investment Company Program, and three, a program to assist State technology development programs.

Now, that sounds very positive to me, but it seems to duplicate the Small Business Investment Company Program that is already in existence. Would we be creating two bureaucracies administering the same type of a program?

Secretary BROWN. Certainly, it would not be our intention to do that, Senator, but, rather, to supplement, if anything. I think, clearly, there needs to be coordination with existing programs, as I indicated in my conversation or discussion with Senator Rockefeller. I think financing is an extraordinarily important issue in this regard.

I think one of the reasons why we have not made the kinds of advances that we need to make in technology is because capital has not been readily available. My judgment is that anything we can do to increase access to capital will vastly increase our competitiveness. We will need to look and see if there is duplication. If there is, then we certainly ought to take steps to assure that it is not the case.

Senator PRESSLER. I am always one to believe strongly in making the Government we already have work. I am not criticizing this, but why not just expand the SBA's successful Small Business Investment Corporation Program? Would that be an alternative here?

Secretary BROWN. It might well be. I would have to discuss that with the drafters of the legislation, and determine their intention. But I would think that focus, as I indicated, on capital formation, and on providing financial resources for technological development is certainly an appropriate kind of goal.

Senator PRESSLER. I am told that according to Venture Economics, the leading venture industry information source, some \$1.6 billion of SBIC financing, cumulatively, has been used to support advanced technologies in the early years of development. These funds have leveraged an additional \$7.1 billion from other private investment sources.

Maybe that is not enough. But it seems, though, that we could build on that, or maybe combine the two or put one with the other, or something. I would appreciate your written response to that, your analysis.

Secretary BROWN. Certainly, Senator.

[The information referred to follows:]

The basic problem, Senator Pressler, is that the venture capital industry is itself undergoing a tremendous shift. Venture Economics, the same organization you cited, tells us that venture capitalists in the past used to fund early stage deals but are increasingly turning to larger, later stage financings. In fact, we understand that whereas 10 years ago, 53 percent of all venture capital financings could be called early stage, today only 22 percent can be called that. We are not aware that SBIC's have bucked that trend. In fact, it is our understanding that one of the main reasons Congress passed the Small Business Equity Enhancement Act of 1992 was precisely because SBIC's were forced to take a short-term outlook because of weaknesses in the financing mechanism used by SBA that obligated them to make immediate interest payments before sufficient revenues could be generated. So, the real question that the administration has to explore is whether the improvements made to the SBA program are sufficient to meet the needs of high-technology firms in today's markets without a special program. That is what I want to explore with my colleagues.

Senator PRESSLER. I think it is something worth analyzing. I am not arguing it. I am not saying it is a flaw, necessarily, but something we have to look at.

Secretary BROWN. Certainly.

Senator PRESSLER. Let me ask some questions about this nationwide fiber optics cable proposal. I do not know if it is a proposal, per se, but I saw USA Today had a big article on it last Friday, I think, about the administration's desire or Vice President Gore's desire to have a nationwide network that could hook up to supercomputers and homes, even, with fiber optics cable.

Now, what does this bill do in that area?

Secretary BROWN. I do not know that the bill does anything in that area. I do not think the bill chooses a technology. I think we talk about networking and the need to build a telecommunications superhighway. But, in my judgment, the bill, nor the administration, favors any particular technology. It is true that there has been a lot of work done in fiber optics. There has been certainly a lot of investment made in fiber optics technology. It seems to be working well.

But I do not believe that either the bill or the administration has expressed a technological preference.

Senator PRESSLER. What is your vision for this nationwide highway, or whatever it is called? I mean what is it, first of all?

Secretary BROWN. Well, to put it in simplest form, if a child at home can plug in Nintendo, they ought to be able to plug into the Library of Congress. We ought to have information available as broadly as possible to all the people of our country. We have tremendous resources here. We need to make sure that those resources are broadly shared.

I do not think we are doing that effectively now, and I think building a telecommunications superhighway gives us the opportunity to do that. It makes us more competitive. It helps business and industry. It helps educational institutions. It helps the delivery of health care services.

I think it just makes us not only a stronger economy but a better country.

Senator PRESSLER. It was always my observation that the inner cities and rural areas or small cities, inner cities and small cities, were the last to be wired for cable TV. I am fearful that this inter-

state fiber optics network or highway will leave out those two areas. How can we prevent that?

Secretary BROWN. I think it is going to take vigilance on the part of the administration. I think it is going to take working closely with the private sector. After all, they are the ones that make the investments and make the basic judgments on where to start building a system.

It seems to me we have to use all the influence we have to make sure that there is fairness and equity in the process. I am familiar with the complaints that have been raised in the past about those decisions and certain areas and communities being excluded. And this administration is prepared to take necessary steps to make sure that is not the case in the future.

Senator PRESSLER. I represent a small State, which chief industry is agriculture. Our second industry is tourism. But our largest city is 100,000. Then we drop off to small cities, small towns. When I am reporting to my constituents in my listening meetings as to what is in this legislation for them, and that is not their only concern—we are all interested in the United States and the world doing well, and so forth—I need to know what will this legislation do for a small city and rural people?

Secretary BROWN. I think it does a lot for America. I think if you make America more competitive, which we are all committed to doing, you really increase economic opportunity for all of our people. That is the bottom-line goal of this legislation, as I see it. By using our intellect and, as we direct it toward advanced technology, that creates economic opportunity.

In my judgment, that would be economic opportunity not only in urban America and suburban America, but in rural America as well.

Senator PRESSLER. That is true. I agree with that. That is a general thing. But if I am going to—the chances of our having some of the facilities located there or the chances of getting fiber optics or being on the fiber optics highway are less so. What specific examples can I give if I am speaking in Aberdeen, SD?

Secretary BROWN. I think, Senator, you might consider using the example that I just used, a schoolchild being able to plug into the Library of Congress. That would seem to me to be pretty good incentive for a rural educational apparatus as well as an urban.

Senator PRESSLER. And that will happen in rural areas, small cities, small towns?

Secretary BROWN. It will happen. It can happen by satellite. It can happen by fiber optics. It can happen a number of ways. But, first, we have to really provide some leadership to putting together the kind of telecommunications superhighway that S. 4 envisions and that this administration envisions.

Senator PRESSLER. Now, where in this bill can I cite evidence that it will help people in small cities and rural areas?

Secretary BROWN. I would have to review each section of the bill, Senator. But you can, I think, take it from my testimony that this administration is committed to making sure that resources are equally spread across the length and breadth of our country. That rural areas are not ignored. I have had a number of conversations

with Senator Burns about this issue. He expresses the same concern that you are raising, that rural areas not be ignored.

But, frankly, one of the things that has happened in America over the last two decades or so, with the expansion of cable television and other telecommunications technologies, rural areas have fared relatively well as far as being able to be hooked in to what people in urban areas were hooked into for many years. And I think the more we expand, the more we provide opportunities for rural areas.

Senator PRESSLER. Good.

I find that it is not just South Dakota or rural States that we think of as agricultural. I find, like the airline deregulation issues, I find upstate New York and central California have many of the same problems that we have. So, I look forward to continuing discussions with you in those areas, and I hope on the small business front we do not create two bureaucracies doing almost the same thing. If we can even move one to the other or something.

But the SBIC program has been pretty successful, and it is pretty well administered, I think. It could be improved.

If there is a reason to create another parallel one, it is strictly for technology. But they have done a lot. SBIC's have done a lot in the technology area. I have got a list of the computer companies and so forth that have been formed as a result of SBIC's. So, maybe we could do it all in one place, or maybe there is an argument or maybe there is a reason that we cannot.

The CHAIRMAN. Very good.

On the point of rural development, I am just as interested as the distinguished Senator from South Dakota. Right to the point, South Dakota perhaps still has a higher per capita income than South Carolina.

I hope we can get ahead, but usually in my political career we have been near the bottom in per capita income. This is not a rural development or an urban development. This is a technological development program, and on that basis you have got to come in with a 50 percent.

Let me elaborate on Senator Bryan's concern about how you get one of these things. That is exactly it. It has to come in with at least enough of the 50-percent financing and then keep it going, and finally after the 6 years take over the entire financing. But more particularly, we have a competitive process with the peer review.

Since they have been characterized as Hollings Centers, let me level with everybody. I am also chairman of the Subcommittee on Appropriations. I meet with my counterpart Congressman Neal Smith over on the House side, and it was allowed we had a struggle to get this thing even going. And one of the grave misgivings of everybody that this was not going to be pork.

And incidentally, the Senate's record is pretty good on that. In last year's highway bill, we did not have a single demonstration project when we passed the highway bill. We did not have any pork. The pork came about in the conference with the House. [Laughter.]

And on this particular score, there is not going to be any pork, and they gave my State's proposal a double review.

We are in competition with seven other finalists, including one other in the Southeast. The reason we prevailed, and it is very significant, was the extension service we had with our technical training centers. Now, you hear Secretary Reich over in Labor saying we ought to have the apprenticeship program. When BMW was coming to South Carolina last year, von Kuhnheim, the chairman of the board, sat down with me. And he said the big reason for locating in South Carolina is your technical training centers. We can get the skills.

We set that up 30 years ago and have been cleaning everybody's clock on the very premise that a young lad in high school saying "Look I am not doing well in these sciences, and there is no reason for me to be studying French or Spanish. Daddy is driving a rig all the way across country, mother is working in the restaurant, I am going to quit to help the family."

The dropouts are not on account of indolence, in major part. Dropout in our high schools has been occurring on account of ambition. We could say well, you do not have to study the languages. You come over here in the technical training centers and instead of getting \$7 an hour you could take a course here for 6 months and get \$10 or \$11 an hour. And that has been working like gangbusters.

Michelin has its own facility right in our Greenville Tech on how to make tires. They have 7,000 Michelin employees, and I could go on and on beyond my time. But the reason that we prevailed was not only they offered the money and the combination of the University of South Carolina and Clemson University both getting together on it, but we had the outreach and extension. It is already working and we get audited and we continue to get the peer review.

So, I told my good counterpart Chairman Smith, I said "Look, if we start putting or writing into the bill Hollings Centers or manufacturing centers, the program is dead. It is going to become pork. It has got to be administered by the Secretary of Commerce with his own peer review." So, I thought publicly you and I had not had a chance to discuss this, but this is a wonderful opportunity for everybody to understand the ground rules.

There is no pork in this one, and there is no rural or urban development. It is getting together the financial effort and interest in technology, whether it is in South Dakota, South Carolina, or wherever.

Otherwise, very quickly, Mr. Secretary, with respect to the GATT agreement, Prime Minister Major is now meeting with the President, and I know he is imploring the President we have got to sign it immediately or we are going to have a trade war. Well, of course, we have a trade war. Let us get away from the shibboleth and understand that it is real, it is very competitive, and it is very good.

The Japanese are leading because they have the best defense, so to speak. If I were in Japan—I do not bash Japan—by cracky, I would run it the same way. They are taking over markets like gangbusters, and people are willing to go along with a keiretsu and a protrust arrangement on Main Street Tokyo and the pricing and everything else like that.

So, it works. And the only way we are going to stop subsidizing their protectionism is to take a page like Roosevelt did in the days of the depression. In order to keep the banks open, he closed the doors. In order to save the farms, he plowed under the crops. In order to remove a barrier, we are going to have to raise a barrier and then remove them both.

The duty of the Government is to open up free market and free trade. But the only way we can open up those doors is to be competitive. And in that light, the Dunkel text is important. When Ambassador Hills came before us she was going to strengthen the dumping laws. Now, we find out that instead of just one company being injured and bringing its dumping charge or claim, you have got to get the entire industry. You have got to get the entire industry together before you can really proceed under the Dunkel text that is ready to be approved. Or you have got to average out the dumping sales with the nondumping.

They are weak. I can go down the list. I see my time is short, but on that particular score, look very, very closely, Mr. Secretary, on whether we are strengthening our position, with all of these fast tracks and everything else like that. Every time they have ever appeared they have said we want to strengthen the dumping laws, and the Dunkel text that they are trying to force a signature on the part of the President of the United States actually weakens, it weakens those things.

Let me yield now to Senator Rockefeller.

Secretary BROWN. Senator, if I might comment?

The CHAIRMAN. Yes, sir.

Secretary BROWN. I have stated, both publicly and privately, and when I say privately I mean in meetings with representatives of the EC and other representatives of foreign Governments who have come to visit me since I have been Secretary of Commerce, that the Dunkel text is not satisfactory, that it needs to be changed in a number of respects. And I have said repeatedly that a good agreement is better than a fast agreement.

That does not mean that we are trying to unravel anything. It does not mean that we are trying to deliberately slow anything down. We want to move ahead appropriately. But what we are interested in is a good agreement that allows us to have the kinds of antidumping laws, countervailing duty laws, that can help level the playing field which is not level now.

The CHAIRMAN. Thank you.

Senator Rockefeller.

Senator ROCKEFELLER. Thank you, Mr. Chairman. Senator Presler was talking about rural areas and fiber optics and cable. West Virginia, I think Mr. Secretary, was the first State that was laid for cable. So, it does not have to be, if one is vigilant, it does not have to be just the urban areas that get that.

Another comment off point here, but very much on point for the future, you introduced John Rollwagen, and I guess some people call him Jack. I will call him John because you called him that. I think his selection by you is tremendous as a statement for people who want to see an advancement of our technology policy, and again, the concept of a partnership, a public-private partnership,

where appropriate. I think it is a very, very strong decision and I am very happy about it.

I also want to make another comment. I think it is really interesting the way the country seems to be responding to the President's economic package so positively. I think it was not just the overnight polls or, as Bob Dole said, "The good speech." You know, this stuff is lasting and it is growing. I think the hunger of the people for—that they have a sense that we need to get on a sound track again and that they elected the person to do that and that he is doing it is very palpable.

I spoke at the U.S. Chamber of Commerce yesterday at lunch, and the President addressed them in the morning, and the whole place was really just abuzz with a sense of excitement. That would not ordinarily be a group that would applaud a Democratic President, but he was interrupted 30 times by applause during the course of the speech, and people there were really excited by what he had said.

I think the message from that is that when you get leadership people respond to it. I just think you are going to see that in a whole lot of lobbying groups and organizations. They respond to a mandate when the President exercises leadership. Well, that is just my little extra thought.

One of the—again, getting back to the Advanced Technology Program, you now award joint R&D ventures. But they are limited to a minority cost of joint ventures. But when you come to awarding similar awards to individual companies, the limits are different. In other words, there are not those limits. And so the joint R&D ventures as opposed to an individual company, what is different? Why the difference? And I do not expect you to answer this now, but I think it is an interesting point, because a private sector firm or institution, regardless of its size, potentially ought to be able to take advantage of a 50-percent relationship on that. And I do not expect an answer now unless you have one, but I would like to know.

Secretary BROWN. Well, as I recall, I think part of it has to do, Senator, with the way it is calculated. I think costs are calculated in different ways, and it is my recollection that it comes out to about 50-50 under both scenarios.

Senator ROCKEFELLER. You are saying that it is not stipulated as being different as between the two?

Secretary BROWN. I think it might well be stipulated, but I think as it actually works, as it actually works, it is about the same in both cases. But I will be glad to review that for you and be more responsive to you.

[The information referred to follows:]

ATP COSTSHARING

The ATP enabling legislation contains different costsharing requirements for joint-venture and single-company applicants. Joint ventures must provide "matching funds," i.e., the majority of the resources (including appropriate in-kind contributions) needed to carry out the technology development program. ATP fully reimburses joint-venture partners for appropriate indirect costs. Single-company award winners are required to pay all indirect costs as their cost share. The single-company costsharing requirement provides some advantage to small- and medium-size businesses that generally have much lower indirect cost rates (general overheads) than larger companies. Thus, small single-company awardees generally pay under 50 percent of the total ATP research costs and large companies generally pay more

than 50 percent. Nearly 70 percent (29 out of 42) single-company award winners are small businesses. This is the reason that private sector funding for single-company projects is slightly under 50 percent. The following table summarizes the ATP and private sector costsharing for both single-company and joint venture projects (figures are in millions of dollars).

	Joint ventures	Single company	Total
ATP	122	65	187
Private sector	147	63	210
Total	269	128	397

Senator ROCKEFELLER. Thank you, Mr. Secretary.

On a further matter, the Export Enhancement Act of 1992, that is something that some of us cared about a lot, and that was the whole idea that—you know—that agriculture is 1 percent of our people, 10 percent of our exports, and 74 percent of our expenditures on export promotion. One of the things that happened in that is that you were made the statutory chairperson of something called Export Promotion Coordinating Committee, which I think involves 16 different agencies.

Secretary BROWN. Yes—19, I think it is.

Senator ROCKEFELLER. Nineteen different agencies. You are required, and probably obviously have not had a chance to do so yet, but you are required to develop and implement sort of a coherent budget plan, as well as a coherent approach in terms of export promotion. I would be interested, as you get into that, how you see that working and whether, in fact, we will be able to target export promotion money to those things which the Government, in its wisdom, decides is most important for the national economic interests. Because I think those two ought to relate to one another, not just where the strongest lobbies are.

Secretary BROWN. Well, Senator, it is my hope that being chairman has a practical result in that regard. I intend to be aggressive. I think that we have not utilized the Trade Promotion Coordinating Committee adequately. It is my understanding that it has only met once, at least the principals have only met once, since its existence.

If, in fact, the one bright spot in our economy that has the potential of being even brighter is exports, it ought to be an area of my focus. We ought to be striving to increase exports in every possible way. And I say—I believe that using this already existing vehicle is an appropriate way to do that. I am concerned, too, that, as you point out, agriculture represents about 10 percent of our exports, but it represents almost 80 percent, as I understand it, of the dollars that we use for export promotion. We need to take a look at that. We need to take a look at getting a maximum bang for the buck, and I think that deserves some review.

Senator ROCKEFELLER. And in addition, Mr. Secretary, I would be interested in the relationship, which is now more formalized, between the Export-Import Bank and the U.S. and foreign commercial service, because that has just as much to do with small- and medium-sized business's instincts to export. Your people in Commerce hook up with the Export-Import Bank people, which for the most part are lending the moneys to rather larger companies.

Secretary BROWN. You will be pleased to know, Senator, I have already had a number of conversations with Ken Brody, who the

President has nominated to lead the Ex-Im Bank. He is anxious to work very cooperatively with us. I am very encouraged by our initial conversations.

Senator ROCKEFELLER. Great. Just one final question which has nothing to do with S. 4 but it is in the same area. The President's economic package eliminates trade adjustment assistance. Not for workers, which you cannot do, it is statutory, but for firms. And it is a \$14 million program. Eagle Convex Glass in West Virginia right now is taking advantage of that. And I am just kind of curious as to why that was eliminated, because it is the same theory as with a worker. If a company is having difficulty because of imports, the Government sends in some people to help them figure out how to do things better or whatever. I am just really not sure why that is not working.

Secretary BROWN. I share your concern, Senator. You know how difficult these budget cuts were.

Senator ROCKEFELLER. Yes.

Secretary BROWN. I sat with the President and the rest of the National Economic Council while decisions were made on all of them—all 150 of them. None of them was easy. This one was no easier than the others, and it was a matter of just making some tough judgments.

We are committed to reducing the size of the deficit, we are committed to tightening our belts, and we had to make some very difficult decisions. And the one you referred to was one of them.

Senator ROCKEFELLER. But if I came up with another \$14 million cut somewhere else—

Secretary BROWN. The President said he would certainly look at all the spending cuts proposed by the Congress.

Senator ROCKEFELLER. Thank you, Mr. Secretary. Thank you, Mr. Chairman.

Secretary BROWN. Let me add, if I might, Senator Hollings, I just want to express agreement with Senator Rockefeller's assessment of our decision to ask John Rollwagen to come on board as my deputy. His nomination has not been officially submitted yet. We are anxious for that to take place so that the committee can move forward with confirmation hearings, and also, Senator Rockefeller's assessment of the President's economic proposals.

The CHAIRMAN. And I agree very much with what you have said and with what Senator Rockefeller said on John Rollwagen. I think we are very lucky to have him. They look upon us as politicians and liberal spenders. Rollwagen is a very, very successful businessman, tremendously successful in the highly competitive field of technology, supercomputers and otherwise, and we need that credibility, both you and I, Mr. Secretary.

Secretary BROWN. Maybe we can confirm him today, Senator.

The CHAIRMAN. Well, if you get the nomination up I am ready to confirm him.

Senator BRYAN. Mr. Secretary, let me shift the focus just a little bit. In your prepared text you make the comment our economic future depends on the ability of business to move technology rapidly from the laboratory to the marketplace. I could not agree more.

It seems to me that we celebrate and rejoice as Americans when a number of Nobel laureates are announced each year and they are

Americans. And even though some of us may not begin to comprehend the technology that is being honored, nevertheless, we have in recent years seen a number of American technology breakthroughs, developed here in America by our people, and yet that technology is not commercialized so that the products that are a spinoff of that technology are not made by American workers and the entrepreneurial profits are not American businesses.

One that comes to my mind, which is not by today's standards an advanced technology, but the VCR, in effect, invented in the United States, and I do not think there is a single VCR manufactured in the United States.

Secretary BROWN. Right.

Senator BRYAN. Can you give me your thoughts in terms of how we address that situation? Where the technology is there but yet we are unable, through whatever impediment, to get that to the marketplace. And maybe if you would, in that context, comment if you think that the Patent Office is part of the problem or if you have had an opportunity to examine its role in commercializing this American technology.

Secretary BROWN. First, generally, Senator, I believe that S. 4, and I believe that the commitments of the administration deal with the problem that you raise. It is a problem. I said, in my testimony during my confirmation hearing, that in fact we were geniuses at positioning ourselves to get Nobel prizes, but somebody else was getting the profits. And we need to focus on commercialization.

I believe that is what the manufacturing technology centers do, I believe that is what the ATP program does, I believe that is what the partnership that we are forging with the private sector does. And it has become even more important now, because if you are going to be competitive, the time from creation or discovery or innovation to commercialization and to the marketplace is growing shorter and shorter.

What used to be the case was that maybe from the beginning to the actual point of sale was 2 or 3 years. Now, it is sometimes 8 or 9 months and you might have obsolescence in 2 or 3 years. So, it really behooves us to focus on implementing—passing and implementing S. 4, and to recommitting ourselves to understanding that it is not just technology for technology's sake, but technology for the sake of commercialization and exporting and creating jobs for our people here at home.

Senator BRYAN. Well, I am pleased to be a supporter of the legislation, and I again look forward to working with you.

Let me ask you another question with respect to the coordination. The role of the national laboratories, the LASL's, the Los Alamos Scientific Laboratories, what used to be called the LRL at Livermore I think is now LML—has changed under legislation which this committee process in 1989, so no longer are they simply involved in developing weapons systems for the national defense effort, which they did commendably, but they, too, are now searching for expanded opportunities, and there is some joint public-private sector partnerships that are developing with respect to the laboratories out of the Office of the Department of Energy, particularly

in the area of solar, which is an interest that we have in Nevada, as you might suspect.

What type of coordinating mechanism, as you are looking at funding some of these technology applications to see that there is not a redundancy between what is being done by another Department of the Federal Government worthy and entitled to support, but so that we are not getting involved in cross purposes.

Secretary BROWN. Well, the national laboratories, as you know Senator, are really a national treasure.

Senator BRYAN. They are, indeed.

Secretary BROWN. A real opportunity for us. My judgment is that there has not been enough coordination in the past. I will obviously be in discussions with Secretary Riley at Energy, Secretary Aspin at Defense, and others, in making a determination of how we can better coordinate, how it can be a part of what we are doing and what the purposes of S. 4 and other legislation how we, in fact, move from military or defense technology to civilian technology. That is one of the principal goals that we have.

As you know, there is already some action on that as far as defense conversion generally. I sent a letter to Secretary Aspin 2 days ago for the transfer of some resources from Defense to Commerce in this regard. So, it is an area that we are working on. We know there is a lot of work to be done on it. We do not want redundancy, we do not want duplication, but we also recognize that there is great potential with the national labs.

Senator BRYAN. Finally, my last question is this: There has been some comment in certain private-sector groups that the antitrust laws in this country need to be revisited in terms of we have made some changes, as you know, with respect to combining for purposes of doing some research. But are there areas, in your judgment, where some of these undertakings are so gargantuan that they cannot be undertaken, even by a single company, dominant as it may be, in a particular field.

Do we need to revisit the antitrust laws to see whether it would be appropriate in certain cases, if the private sector, various companies, ought to be permitted to work together not only in research but in certain types of advanced technology production? Is that a problem? Have you had a chance to look at it or not?

Secretary BROWN. I have not reviewed it thoroughly, Senator, but I might say that it deserves review. We are in a new era where cooperation is required. I might note that when the President issued his technology statement day before yesterday, he indicated that reform of antitrust laws is essential to permit joint production ventures, and really indicated that the administration was going to forward legislation of the Congress which would extend the National Cooperative Research Act of 1984 to cover joint production ventures. So, clearly, we have gotten the message and will be having further review.

Senator BRYAN. Mr. Secretary, as always, it is a pleasure to visit with you. Thanks so much, and thank you, Mr. Chairman.

Secretary BROWN. Thank you, Senator Bryan.

The CHAIRMAN. Thank you, very much. I appreciate Senator Pressler and Senator Dorgan yielding at this point so I can recognize Senator Krueger.

Senator KRUEGER. Mr. Chairman, thank you very much for this opportunity. I regret that I was at another committee hearing and was not here for your verbal presentation. But I did read your testimony and I was pleased throughout with the testimony, and in particular I suppose I took pleasure that SEMATECH in Austin, TX, is seen as a model of private- public partnership.

I think that the direction that you are taking the Department of Commerce, as indicated both by your testimony and other statements, of recognizing that our real competitors today are international. And in conformity, I guess, with the comments just made by my colleague Senator Bryan, I think that we need to recognize that we cannot live, really, with the regulations necessarily that were appropriate in the 1930's in the 1990's if the nature of competition has changed, if the nature of monopolies has changed, if the nature of trusts have changed.

I think that your direction of recognizing public-private partnerships is in keeping also with the suggestions that I have seen in today's press and yesterday's press coming from our Secretary of Education and our Secretary of Labor of retraining our workforce in a different kind of fashion so that we will be internationally competitive and can learn from our international competitors, and frankly, can stop the attitude of viewing labor versus management and can try to recognize that in a sense we are all in this melting pot together and we really need to have strong partnerships, not only between labor and business, but between business and Government and labor.

I commend the direction that you have given in that regard. I am wondering whether you might just give us some sense of what you think we could learn from some of the other countries, you know, whether it be Japan or Taiwan or wherever, in terms of the effectiveness of how they have used Government-business partnerships in a fashion that we could look to in the future, just in broad general scope.

Secretary BROWN. Certainly, Senator. I think we can learn an awful lot. I think we have not been too quick on the uptake in learning. I think we have been rather slow learners. I think it is time for us to rather speed the learning curve, so to speak.

I think the first thing we can learn is communication. There has got to be some communication between the public and private sector. There has not been a whole lot. It has been very superficial, when it has taken place. We need to change the terms of the relationship. We need to continue to talk, or begin to talk about partnership, about building a supportive relationship where Government is there to support American business and industry.

I think we need to be much more aggressive. I noted the other day, when I was talking to a business group, that President Mitterand, for example, finds no trouble getting on an airplane and flying off to a foreign country to promote the interest of French business and industry. I wish he was promoting American business and industry, but French business and industry. This administration ought to do that, too.

I want to be a Secretary of Commerce that, when an American company is competing for a business opportunity overseas, I ought to get on a plane if that is necessary and go visit with the leaders

of that country, with the business executives in the country, and be a real advocate for American business. That would be a change in approach. I think a change in approach is necessary.

The CHAIRMAN. If you do that approach, do not fly the Concorde. [Laughter.]

Senator KRUEGER. My recollection is, when asked once about whether he would continue to fly first class he said, "Unless there is a better way."

Secretary BROWN. That was Strauss not Brown. [Laughter.]

Senator KRUEGER. That completes my questioning. Thank you very much, Mr. Secretary.

The CHAIRMAN. Senator Pressler.

Senator PRESSLER. Mr. Chairman, I shall be fairly brief here. I am trying to figure out what is the estimated cost of this bill in the first full year of its operation.

Secretary BROWN. I respectfully refer that question to Chairman Hollings.

The CHAIRMAN. Well, in general terms, Senator, what we are doing is relaying about \$435 million between advanced technology manufacturing centers and the research endeavor itself in the National Institute of Standards and Technology. We are going to convert from \$435 to \$975 million. In other words, from one-half a billion to \$1 billion the first year, and \$1.5 billion the next year. That is in the light of some \$70 billion that we have in research money that we have over there in DARPA.

Senator PRESSLER. So, let me figure this out. DARPA is not a part of this over in DOD?

The CHAIRMAN. That is right.

Senator PRESSLER. Now, we have NIST lab research, NIST research facilities, NIST manufacturing, NIST ATP, and the biggest one is NIST ATP goes from \$68 to \$210 million in fiscal year 1994 authorization, to \$420 million in fiscal year 1995. Now, what is that?

Secretary BROWN. What we are going to have to do, Senator, is to work with the committee. I would hope to try to conform some of these numbers to the President's economic plan. In that economic plan, we did give emphasis to the same areas, NIST and manufacturing centers being a part of that.

As I recall, in the stimulus package we added \$117 million to the NIST budget. We took it from somewhere on the order—just under \$400 million a year to about \$1.3 billion a year as a demonstration of commitment to technology. So, these numbers are not exactly the same as in the President's proposals, but they do give emphasis to the same areas of development.

Senator PRESSLER. OK. Now, I am always concerned about some of that money getting to smaller universities. I know that there is an EPSCOR program in scientific research to get things away, sometimes, from the big 10 and the Mississippi Valley universities and the Ivy League. They get most of this money, I suppose, these grants.

Secretary BROWN. No, that is not true, Senator.

Senator PRESSLER. It is not true? What is true, then?

Secretary BROWN. What is true is that they are bottom-up grants under the ATP program. They come from private industry. They re-

quire a match that has nothing to do with rural or urban or anything else. It is a peer-review evaluation.

Senator PRESSLER. Right. I know all the peer-review guys are from the Ivy League and the Mississippi schools.

Secretary BROWN. No, the peer review, Senator, are from American business. They are not from educational institutions, they are business people who are the peer reviewers.

Senator PRESSLER. Well, they are business people, but they are also the peers of the people who are in the system. And what we found with other scientific research, to break that up a little bit, we have had a EPSCOR program. Do you envision anything like that to get some of the money to places and schools that are not in the peer review system?

Secretary BROWN. I do in other programs, Senator, but universities are not a part of the ATP program. This is not a university-directed program.

Senator PRESSLER. Well, wherever it is done, then.

Secretary BROWN. Certainly.

Senator PRESSLER. I would like to get a written analysis from you. There is a program called the EPSCOR program to help get scientific research to areas, and places, and universities, and businesses that are not normally involved in this system to expand it a little bit.

Secretary BROWN. Is that a National Science Foundation program, Senator?

[The information referred to follows:]

The National Science Foundation administers the Experimental Program to Stimulate Competitive Research (EPSCoR), which is a merit-based program initiated in 1979 to assist less competitive States meet the challenge of increased competition for Federal research and development funds. EPSCoR brings a State's academic research endeavors to nationally competitive levels by enhancing selected research areas and by stimulating local action to effect systemic improvements in the scientific and engineering infrastructure of its research universities.

The Department of Commerce, through the National Institute of Standards and Technology (NIST) has several programs designed to award grants for the advancement of technology and technology transfer, focused on enhancing the competitive advantage of U.S. industry. These programs include the State Technology Extension Program (STEP), the Manufacturing Technology Centers Program (MTC), and the Advanced Technology Program (ATP). The STEP and MTC programs are specifically aimed at small- and mid-sized businesses; the ATP is not restricted to company size. All three programs are based on competitive proposals. In contrast to EPSCoR which awards grants to universities and colleges, the NIST outreach programs, consistent with its mission as stated in the Omnibus Trade and Competitive Act of 1988, are intended to assist industry directly.

The NIST State Technology Extension Program works with individual States to help develop coordinated technology assistance programs that are appropriate for serving the needs of industry in that State. STEP activities are particularly important to small and/or rural States that may not currently have the resources, or the industry demand to support an NIST MTC. Over the past 3 years, the NIST STEP has awarded technology assistance grants to 21 States, including 12 States that are considered rural, of which 5 participate in the EPSCoR. One-third of NIST's first stage planning grants have been awarded to EPSCoR States. We feel planning grants are an important first step for States that are developing technology assistance programs. The ultimate goal of the NIST State Technology Extension Program is to provide appropriate financial and technical assistance to all States developing credible statewide, coordinated, technology assistance programs. We are also working with eight additional EPSCoR States through our regional networks program. NIST has recently initiated a program to stimulate and support regional networks of States. On a pilot basis, we are working with three regions, the Upper Northwest, New England, and the Southeast, to initiate a series of working sessions to facilitate increased coordination and cooperation between service providers in those

regions and to address issues of common regional importance. These regional networks will allow States to share program ideas, learn from each other's successes, and, possibly, coordinate interstate service delivery.

Established only 4 years ago, the NIST Manufacturing Technology Centers program is still essentially a pilot program, having established only seven centers to date. To achieve maximum impact with this program, we have been keenly aware of the need for geographic balance. We believe that the current sites are consistent with this objective. We recognize the need to provide opportunity for increased interaction between MTC's and rural States in the same region. The proposed expansion of the MTC program is designed to directly impact all States.

NIST, through the STEP and the MTC programs, is actively working toward coordinating relevant technology assistance programs in order to extend the benefits of these programs into areas not currently covered. We already have ongoing cooperative programs with the Department of Labor, the Department of Agriculture, the Small Business Administration, the Department of Energy, the Environmental Protection Agency, the Department of Defense, and the National Technology Transfer Center. It is our goal to help bring new focus and leadership to the variety to technology assistance programs throughout the Federal Government, coordinating and integrating programs where appropriate, while continuing to build on the strengths of the various Federal agencies involved.

One of the most promising new Federal programs designed to enhance U.S. competitiveness is the Advanced Technology Program, administered by the Commerce Department's National Institute of Standards and Technology. The ATP has been structured to provide grants to technology-based companies or joint ventures of companies to develop precompetitive, generic technologies. All awards are made through a competitive selection process based on technical and business merit, without regard to geographical balance. After reviewing the State-by-State applicant success rate of awards granted after three competitions, we have concluded that many States have not taken full advantage of the Advanced Technology Program. With the proposed rapid expansion of the program (from \$68 million at the beginning of fiscal year 1993 to a proposed \$750 million in fiscal year 1997, including a proposed \$103 million supplemental in fiscal year 1993), we have redoubled our efforts to encourage competitive proposals from all States. As a first step, we are sending letters to all the Governors highlighting the program and offering to send an ATP representative to their next technology event to make a presentation describing the program in detail.

Senator PRESSLER. NASA and the National Science Foundation are among the agencies that use the EPSCOR program. But in any event, I would be very interested to see if NIST has anything analogous to this, is what I am asking.

Let me ask about the superconducting supercollider. I know that it is not in this bill, but is the administration going to support the superconducting supercollider this year?

Secretary BROWN. With some changes that were articulated in the President's economic plans, yes. We are very concerned about cost overruns. That was one of the big items of concern—massive cost overruns which have to be brought under control. And I think some changes in the program itself are necessary.

Senator PRESSLER. I have always been intrigued because the scientists who studied it found the best place for the superconductor was along the Minnesota-North Dakota-South Dakota border because we are earthquake proof. Then I woke up one morning and read that President Bush had put it in Texas. But suspect that the supercollider would eventually be supported politically.

Now, who determines what critical technologies are in our society? Who are the people who really decide that?

Secretary BROWN. Well, it is obviously jointly decided. I think we make judgments based on data that we get. Obviously, we look to the scientific community for guidance on that. But we ought to also be looking to the business community because commercialization

possibilities certainly ought to move our decisionmaking process as well.

Senator PRESSLER. But in the Department of Commerce, for instance, there is the title of Assistant to Critical Technology Investment Companies. Somebody sits down and decides what critical technology investment companies are.

Secretary BROWN. Well, our Secretary of Technology will provide leadership there. The leadership of NIST will certainly be involved in those decisions as well.

Senator PRESSLER. OK, but they are the ones who are going to decide who qualifies for this. Like, if you have this small business loan program, you would have to issue licenses to the appropriate small businesses first, is that not correct?

Secretary BROWN. That would be a new program. We would have to set up a new process for those decisions. There is not a process yet for it.

Senator PRESSLER. Well, what I am trying to get at is who is going to sit down—who are the people, this assistant to critical technological investment companies. On the question of critical technology in our time, who in this administration really decides that? I mean, the President decides it but—

Secretary BROWN. Well, obviously the President would be talking to the President's Science Advisor. We would be talking to my colleagues, if it was appropriate, at the Department of Energy, the Department of Defense, others involved with technology. So, there would be a review process that would have to be put together, since this is a new effort.

Senator PRESSLER. Right, but somebody has to sign off on a list. Eventually, there has to be a list. Who prepares that list?

Secretary BROWN. I would suspect that that would be within the Commerce Department after consultation.

Senator PRESSLER. OK, and how soon do you expect to have that done?

Secretary BROWN. Well, the legislation has not been enacted yet, so we would certainly wait until the legislation is enacted before we begin to put it together.

Senator PRESSLER. Well, what I am trying to get to is what do you consider critical technologies?

Secretary BROWN. We would have to make judgments on that.

Senator PRESSLER. OK. You do not yet have a clear focus. The supercollider is outside this bill, I know, but would that be within the category?

Secretary BROWN. No, it would not be within that category.

Senator PRESSLER. OK, fine. Mr. Chairman, I have some more written questions for the record. I have to go over the Aging Committee to age a bit. So, excuse me.

The CHAIRMAN. Very good. Thank you very much. Senator Dorgan.

Senator DORGAN. Thank you very much, Mr. Chairman. Mr. Secretary, you talked about the development of technology, commercialization, and then export. I support this legislation and support much of what you have just described as new technology initiatives in this administration. I think it is moving in the right direction.

But our television was invented by Americans, and the television sets are now largely produced by others. The VCR was invented by inventors in the United States. VCR's are now largely produced by others. What do we couple with this to make certain that when we invest in new technology that we are actually going to create jobs to manufacture and produce in the longer term?

Secretary BROWN. I think that is one of the steps that we have missed in years gone by in that we have invented, we have created, but we have not produced, we have not manufactured. I think one of the key things we are doing now is focusing on manufacturing. I think we have, I hope not too late, reached the conclusion that you cannot be a first rate globally competitive economy if you continue to let your manufacturing base erode. So, what we are talking about is providing new technologies to manufacturers, both small and large, so that we continue to manufacture products.

The export I am talking about, Senator, is not exporting the technology but exporting the products that the technology creates which is job creating.

Senator DORGAN. But is it just a question of technology that has led to our not manufacturing television sets and VCR's?

Secretary BROWN. No, that is one of the things. It certainly is not just that. I think there has been in some regards some unfair foreign competition, for example, that has allowed other nations to be more competitive or companies of other nations to be more competitive in the global marketplace.

I think that in some cases our own corporate executives in some of the areas that you have mentioned did not move quickly and aggressively enough. I think they took a lot for granted that they should not have. I think we have been competing against, as we have indicated a number of times here, among companies from countries where there really is a government-business partnership, where they are working together.

So, I think there are many factors. I think cost of capital clearly can be one factor. Access to capital can be a factor. So, I think there are a number of factors, Senator.

Senator DORGAN. So, you are talking the development of new manufacturing technology. You are talking about that for the purpose of creating new jobs in this country.

Secretary BROWN. That is correct.

Senator DORGAN. Are you familiar with the debate we had in the eighties about the FSX—the shipment of the technology of jet fighter airplanes to Japan and Korea?

Secretary BROWN. I was familiar with it then. It has been a number of years now since we have discussed it.

Senator DORGAN. I have long felt that one of the disgraces of public policy in the eighties was in an area where we so clearly lead the rest of the world, instead of when the Japanese wanted jet fighters we asked them to buy them off the shelf in our country because we produce the best in the world, we decided to join with the Japanese in shipping technology to them for one-tenth of what it cost us so that jobs can be produced in Japan, and we lose the technology. The same with Korea.

I thought it was disgraceful to give up our technology edge, and that is what we have done. And, second, to decide that is fine if

a customer like Japan does not want to buy off the shelf the products that we make, which are the best in the world. We will just ship the technology to them so they can produce it over there.

I know there were some joint agreements to maybe coproduce in certain areas, but the fact is I hope we see a new direction in this administration on those kinds of issues. If we produce the best in the world of something, we ought to expect those with whom we trade to buy it off our shelf. We are buying their products off their shelf when we think it is the best in the world. So, I would hope that we see a different attitude in this new administration on things like those kinds of questions, the FSX and others.

I would like to ask, Mr. Secretary, about the manufacturing technology centers in rural America. I know that others have asked you those questions. We have enormous resources in rural America, and even when the Fed is going to say, we are involved in an economic recovery, there will be much of rural America that is in a full scale depression. Much of rural America missed the entire 7 year unprecedented economic expansion, as it was called in the 1980's. My home county lost 20 percent of its population when we were supposed to have had unprecedented economic growth.

Secretary BROWN. Much of America missed it too, Senator.

Senator DORGAN. I guess my question is, when you talk about the programs to try and develop manufacturing technology centers, the so-called Hollings Centers, and the manufacturing outreach centers and so on, are you going to be sensitive to rural areas? If so, how?

And do you have programs underway in the Commerce Department to understand that if we stop piling people on top of each other in 60-story apartment buildings and spread them around, around the country, it is probably better for the country and probably better for production?

Secretary BROWN. Absolutely. I am sensitive to that. Senator Pressler raised similar issues with me earlier. My sensitivity has been increased today by your questions and Senator Pressler's.

As you know, there are only seven such manufacturing technology centers now. We are planning to increase that number to over 100, and you can be assured that we will be very conscious of the fact that they ought to be distributed in a fair and equitable way around the country, and that certainly rural areas should not be excluded.

Senator DORGAN. Mr. Secretary, let me just, for the Chairman's benefit as well, relate just a very quick story.

During the drought, the very severe drought that we had several years ago, there was a businessman from Philadelphia who was watching television, seeing the tough conditions in North and South Dakota and the farm belt. He decided that he wanted to do something to help. He ran a big business.

He decided, I am going to create about 20 jobs out there in North Dakota. So, he called North Dakota and found out, what is the hardest hit county. He put 20 temporary jobs in Linton, ND. It is a company called Rosenbluth Travel of Philadelphia. Rosenbluth Travel now is heading toward a 200-job level in the little town of Linton, ND.

And the owner of that company told me on an airplane, he said this is the most incredible secret I have ever discovered. Linton, ND, is as close to the Hudson River—as close to Manhattan as the Hudson River is with fiber optic technology and the ability to communicate over the telephone wires and satellite. So, they are producing data products and so on out there. And he said, "I have saved 35 percent in my costs, No. 1, and have a better product, less down time, fewer sick days. It is an incredible experience," he said, "to understand the secret out there in rural areas of the country."

And I would just suggest that with new technology and the ability to communicate instantly across the world, there are opportunities in rural America. And I think that if we can take a look at that, even as we take a look at these new technologies for the large manufacturing centers that we normally think of, I think that this administration's plan, and the chairman's plan, and others can be very helpful to helping regions of the country that have hurt a lot in the last decade but that can help this country as well.

So, I really appreciate your answers, and I look forward to working with you on these and other issues.

Secretary BROWN. Thank you, Senator.

The CHAIRMAN. Senator Stevens.

Senator STEVENS. Good morning, Mr. Secretary.

Secretary BROWN. Good morning, Senator.

Senator STEVENS. I find it difficult to get a grasp on this. Let us just take Boeing, where the President was this last week. We criticize the British for subsidizing Airbus. Is this not subsidizing the development of technology in our private sector?

Secretary BROWN. I do not consider it that. I think what it does is, first of all, it is not product specific. It is developing new technologies that will help our economy generally. It is not necessarily industry specific. But it helps us take technology from the conceptualization phase to the commercialization phase. So, I do consider it different, Senator Stevens.

Senator STEVENS. Well, I spent a lot of my time on the defense program over the last 15 to 20 years, and in the space program. Much of the technology that was forced to be developed in those programs did spin off into the private sector.

Is this going to replace the R&D in the space program and the defense program?

Secretary BROWN. No, it is not going to replace it, Senator, but we are making an attempt to move from military-defense technology to civilian technology, which I think is absolutely appropriate. It does not mean that there is no more defense or military related research going on, there certainly is. But it just seems to us that a shift toward civilian technology is appropriate, and this is one of the things that helps us to do that.

Senator STEVENS. But who is going to decide what are the generic technologies that we need to develop?

Secretary BROWN. I think the marketplace will decide. These suggestions come from the private sector and not from Government. The ATP program is based on private sector initiative, not Government initiatives.

Senator STEVENS. Well, are not most of those generated by the desire of private industry to go into the development of some new

technology like, say, the V-22, the new aircraft we are trying to pursue?

Secretary BROWN. Some of them—

Senator STEVENS. Why would we not be better off to put this money directly into something that has already been proposed like that, and develop this new concept of transportation?

Secretary BROWN. Well, some of the things do go into technologies that have been proposed before. They are not all things that have never been heard of before. And through the manufacturing technology centers, we really would make an effort to disseminate those new technologies to small- and medium-sized businesses, so you really move toward efforts to create jobs and create economic growth. I do not think that the two are mutually exclusive.

Senator STEVENS. But the latter that you just mentioned is, I take it, to move to develop technologies out to implementation by small- and medium-sized business. Is that right?

Secretary BROWN. That is correct.

Senator STEVENS. Well, that is not developing new technology, though; is it?

Secretary BROWN. I think initially it is developing new technologies. I think you have to separate, Senator, the ATP program from the manufacturing technology centers program. I think the manufacturing technology centers program is more dissemination. It is getting those technologies out to new businesses. The ATP program is really the development, through a public-private partnership, of those technologies.

Senator STEVENS. You know, I think that the concept of these MTC's, or I am told I can call those Hollings Centers. Did you know that?

The CHAIRMAN. Yes. [Laughter.]

Senator STEVENS. That is one thing, because that really is finding a way to implement through small- and medium-sized industry the ongoing adaption of our new technology into the marketplace. That is one thing.

Secretary BROWN. Yes.

Senator STEVENS. I see a Government role in that. But I do not see a Government role in trying to decide which business should be involved in the development of precompetitive generic technologies. That is a pretty big bite, Ron.

Secretary BROWN. Senator, first of all the ATP program is not new with S. 4. The Congress has previously taken action on the ATP program and most who have evaluated it think it is one of the most successful things that we have done. And S. 4 attempts to build on those successes in building that kind of partnership between Government and the private sector.

Senator STEVENS. What are the—I understand it is out there, and it is in sort of an infancy, but it just seems to me that you are going to make it into a giant before it is grown up. What are the successes of ATP?

Secretary BROWN. Let me give you a couple of examples, Senator. Let me cite some specific ones. There is something called—a business with the name of CIC. It is a small business that is making great progress on an ATP project involving computer recognition of

cursive handwriting. CIC has already concluded a licensing arrangement with IBM in the United States and it is expected to control a large portion of the Japanese market in this innovative area through an agreement with the NEC.

Another would be Hampshire Instruments, another small company, that has joined with McDonnell-Douglas Electronic Systems and has developed a new type of high-powered laser x-ray source for semiconductor device manufacturing. This development has made possible applications to a number of commercial technologies. So, again, it was not just directed to one, it was getting a technology that can be used in a variety of ways.

Another called Nonvolatile Electronics, Inc., was a small startup company which has made great strides in their project to develop an advanced random access memory for computers. And they have recently joined forces with a large U.S. supplier of memory chips in the possible commercialization of that technology.

So, there are a number—we have a number of success stories. I would be glad to submit them for the record.

[The information referred to follows:]

EARLY ATP SUCCESS STORIES

In its first three competitions, the ATP funded 60 projects, including 18 joint ventures. They cover a broad spectrum of technologies, including agriculture, biotechnology, microelectronics, machine tools, advanced automotive manufacturing, advanced materials, recycling of plastics, advanced data storage systems, information and communication technology, flat panel display manufacturing, and diamond coatings. The initial 60 projects represent an estimated \$397 million of R&D over their lifetime with \$187 million committed by the ATP and \$210 million by the companies. An estimated 20-30 additional awards are expected to be announced by the end of 1993. Some early results of the program are summarized in the last section of this paper.

EARLY INDICATIONS THAT THE ATP IS WORKING

Program Evaluation Plan

The ATP embraces strongly the idea that program evaluation is critical to the development of a results-oriented, efficiently run program. Early on, an ATP Evaluation Plan was developed and measurable goals were identified against which to track performance. The Plan contains four principal elements: Assessing Process Effectiveness and Efficiency; Profiling Applicants, Recipients, Technologies, and Projects; Tracking Interim Indicators of Success; and Measuring Long-Term Economic Impacts Process Effectiveness.

Process Effectiveness and Efficiency

The ATP "Process" consists of carrying out the following principal activities in support of its mission: Soliciting proposals; Evaluating proposals; Awarding funds to companies; Debriefing non-recipients; Linking recipients to relevant research and facilities at NIST (where appropriate); and Managing progress of funded projects and terminating them if warranted.

ATP's activities are directly geared toward successful accomplishment of its mission. Good performance in carrying out its activities can be expected to increase the likelihood of successfully achieving the long-term goals of accelerating the development and commercialization of technologies and refinement of manufacturing practices.

Analysis of internal data to date indicates that the ATP has been extremely effective in reaching potential clients and in conducting a fair and rigorous competition for funding. Statistics show: approximately 26,000 application kits distributed; 3 proposers' conferences held, plus numerous other outreach activities; 3 competitions completed, and a fourth announced; 660 applications received in 3 competitions; over \$1 billion requested and \$1 billion offered by industry in matching funds; nearly 2,500 technical evaluations performed by technical experts; over 500 business evaluations performed by business experts; and \$187 million committed by ATP and

\$210 million provided by industry to meet cost-sharing requirements in three completed competitions.

There is also evidence that the ATP staff has been highly successful in managing the program.

- A third-party interview study of award recipients found uniformly positive responses when asked if they would care to comment on their interactions with ATP staff. (Preliminary results from SOLOMON ASSOCIATES Study, 1992.)

- One of the recipients in a letter commented that "the personnel within the ATP program have been the most responsive of any government organization that I have dealt with over the years. This is extremely critical. The commercial markets in technology related fields move very fast, and a needless delay can result in a promising technology or leave it to be taken over by foreign competition." (Letter from Dr. John Ostrem, Vice President of Research and Development, Communications Intelligence Corporation, June 25, 1992.)

The third-party interview study of recipients also sought feedback on the clarity of application instructions, the usefulness of the Proposers' Conference, problems and benefits they experienced in the multi-phase application/award process, and other aspects of the awards process. The study's results will be instructive in eliminating any problems and improving the process. The interviews have been completed and analysis of the data is underway.

Applicants, Recipients, Technologies, and Projects

The ATP profiles applicants, recipients, technologies, and projects in order to develop an overview that decision makers need for assessing compliance with specific legislative directives and constraints, and for better understanding the scope and potential impact of the program as the number and scope of projects increases. A database on applicants, award recipients, and projects facilitates this analysis. Examples of findings are as follows:

Small businesses are successfully applying for and receiving funding grants from the ATP—both as single applicants and as members of joint ventures. These results verify the important role of small businesses in developing and commercializing innovative technologies.

- About 60 percent of all single applicants in the first three competitions were small businesses; nearly a quarter of joint-venture applicants were led by small businesses; and many additional small businesses were represented as participants in joint ventures and as subcontractors. Over half of the awards went to projects led by small businesses.

ATP is stimulating the formation of joint research and development ventures—a major objective of the enabling legislation. The greatest share of funding thus far has been awarded to joint ventures. This allocation reflects the multiple-company participation of joint ventures, their typically larger project scope, and the absence of the \$2 million ceiling on funding that applies to single applicants.

- In the first three competitions, approximately 100 joint ventures involving nearly 700 participating organizations were formed to apply to ATP.

- Nearly 70 percent of funding in the first three competitions went to joint ventures, and the bulk of matching funds was provided by members of joint ventures (rather than state agencies or third-party investors).

Proposals to ATP come from many technology and industry areas, but have been concentrated in certain areas, particularly in information and communications (including electronics), advanced materials, and manufacturing processes. Funded projects are expected to affect a variety of markets and areas of application, including consumer products, manufacturing processes, medicine, worker health and safety, environmental pollution abatement, transportation, energy conservation, and many others. The breadth of technologies covered by a relatively small number of projects indicates that the ATP can provide an effective mechanism to stimulate economic growth in all sectors of the economy.

- A mapping of the objectives of the 60 initially-funded ATP projects to the OSTP list of critical technologies shows project objectives in every subcategory of the critical technologies list.

- The diversity of technologies rose dramatically from the first to the third competition, with a sharp rise in proposals received and projects funded in the biotechnology and advanced materials areas. Proposals in the first competition were concentrated heavily in electronics.

Most of the projects funded to date are expected to result in new process technologies and, in the longer run, to generate new-to-the-world or next-generation products. These results are consistent with a major objective of the ATP enabling legislation—to refine manufacturing technologies and accelerate the commercialization of technologies. Several of the projects focus exclusively on manufacturing pro-

ess improvements. The following are examples of projects that have both a process and product focus:

- In its efforts to introduce the next generation of thermal insulation materials, Armstrong World Industries will advance the knowledge base for controlling the structure of polymeric foams at the microscopic level during manufacture.
- In their efforts to develop sensor and control technology for complex materials processing, Honeywell, Hercules Aerospace, 3M, and Sheldahl will advance the knowledge base for using neural networks for control systems.
- The Microelectronics Center of North Carolina's (MCNC) development of the manufacturing technology for a new electromagnetic device is expected to spawn a host of new products and, possibly, a whole new industry.

In a very short time, the ATP has attracted nationwide participation by businesses, private and government laboratories, and universities. The large geographical coverage of the relatively few ATP projects indicates that the program can have an impact nationwide.

- ATP-funded organizations (including partners in joint ventures) after just three competitions reside in 29 states plus D.C.
- States having the highest ATP participation are California, Michigan, and Massachusetts. Additional states that are home to more than one ATP participating company include Minnesota, Colorado, New York, Texas, Ohio, Pennsylvania, North Carolina, South Carolina, New Jersey, Delaware, Florida, Missouri, Oregon, Utah, Connecticut, and Illinois.

Interim Indicators of Success

The ATP tracks developments in the funded projects and notes particularly those that have been designated as good indicators of progress towards long-term success. The following "interim indicators" are short-to-medium term outcomes that are expected to herald progress towards long-run economic success: Increased, Leveraged R&D Investment; Increased Collaborations/Strategic Alliances; Strengthened Technology Infrastructure; Promotion of Small Businesses; Creation/Retention of High-Tech Jobs; Conversion of Defense Companies to Civilian Applications; Achievement of Technical Milestones; Shortened R&D Cycle; Protection of Intellectual Property Rights; Investment in Production Capacity; Licensing of Technology; and Improved Competitive Standing.

Internal data collection and analysis, studies performed by participating companies, and third-party interviews, surveys, and case studies are carried out in support of this element of the ATP Evaluation Plan. Currently ATP has the assistance of several private-sector experts, including a leading "technology assessment" university professor and a contractor recognized for program evaluation and work on science and technology initiatives for economic development and industrial competitiveness. A database now under development will facilitate future, more detailed statistical analysis of results.

Despite the fact that projects funded in the first competition are less than two years old, early results show that the ATP is already positively impacting U.S. industry and technology development. Examples follow:

Increased and Leveraged R&D Investment

In three completed competitions, ATP shared nearly half of a \$400 million technology development effort undertaken by U.S. industry.

In a third-party interview of recipients, the majority cited as the single most important impact of the ATP in the first year that it enabled them to pursue work that they otherwise would not have been able to do. Typical responses were the following: "We would not have been able to do this kind of work at all;" and "This is enabling us to keep a highly specialized and trained team together over a long period of time to pursue this technology."

Another important impact cited by all of the single-company award recipients and most of the participants in joint ventures in the interview study was the "halo" effect, whereby receiving the ATP award enhanced the credibility of the company and the technology. Smaller companies emphasized that this assisted them in attracting external funding. Larger companies emphasized the value of increased support to the project from internal management. Typical responses were the following: "The ATP award was a major contributor in developing strategic alliances." "End-users are aware of us now." "The ATP award increased public awareness of the technology and its potential." "Participation has created a positive perception of the company in the marketplace." "Publicity and exposure surrounding the ATP award created an advance market."

Some of the ATP-funded projects leveraged previous federal investments. About 10 percent of the technologies funded in the first two competitions were spawned in federal laboratories. The following are examples:

- Much of the early precursor work to Saginaw Machine Systems' project to develop advanced compensation techniques for enhancing machine-tool accuracy originated in NIST's Manufacturing Engineering Laboratory.
- Garrett Ceramic Components' project to develop a low-cost, non-toxic aqueous gelcasting system suitable for commercial casting of industrial ceramics to near-net-shape draws heavily on previous work done at Oak Ridge National Laboratory.
- Nanophase Technology Corp., found the basis of its nanocrystalline ceramics technology at Argonne National Laboratory.
- One ATP-funded project leverages previous research performed at a Russian Laboratory. X-Ray Optical Systems, Inc., obtained exclusive property rights outside of Russia to develop the Kumachov lens for collimating X-rays (and neutrons) for lithography and other applications.

Two of the ATP-funded joint ventures—the National Storage Industry Consortium and the Printed Wiring Board Interconnect Joint Venture led by the National Center for Manufacturing Science (NCMS)—have attracted considerable additional funding from DARPA and DoE, respectively, approximately one year into the projects.

Increased Collaboration and Strategic Alliances

Joint Venture Collaborations—As noted earlier, approximately 100 joint ventures involving nearly 700 participating organizations were formed in the first three competitions to apply to ATP.

Among the participants were existing consortia which in turn have large memberships (not separately counted in the above figures) that are important to technology transfer.

A third-party study of impacts revealed that over the first year of the projects, the forging of industry-to-industry, industry-to-government,¹ and industry-to-university partnerships was cited as the second most important effect of the ATP. (Preliminary results, SOLOMON ASSOCIATES Study, 1992.)

Comments of joint venture participants indicate the importance attached to collaboration " * * the benefits of collaboration * * * far outweigh the (ATP) dollars received. ATP forces industry members to work together for the common good. * * * In a consortium, everybody wins—lower costs, higher quality processes for everyone in a high-volume manufacturing environment. There's a higher probability of a successful outcome. The time is right for this in this tough economy. In the 60s, we were all rich and didn't need to collaborate; now we do. ATP enables us as a group to do more than any one company could do alone." (SOLOMON ASSOCIATES Study, 1992.)

Eighteen joint ventures were funded in the first three competitions. They have over 100 participating companies, and substantial involvement of universities and private and public research laboratories. Many of the collaborations bring together suppliers and end users with manufacturers, and most bring in university and federal laboratory participants. Joint ventures are facilitating the sharing of knowledge and providing a focal point of industry activity in research and development.

• The National Storage Industry Consortium (NSIC), which was formed about two years ago to apply for ATP funding, has in a very short time become a major focal point of research and development to achieve dramatic increases in data storage capabilities—a breakthrough essential to higher-performance computer systems. Already NSIC has attracted the commitment of approximately \$40 million in private sector and federal funds, and participation by such companies as Hewlett-Packard, IBM, Applied Magnetics, Maxoptix, Eastman Kodak, Digital Equipment, Quantum, Storage Technology, and a number of universities. In the first competition, ATP committed \$5.4 million, matched by \$9.2 million from industry members, to develop magneto-optical recording disks and achieve a cost-effective, four-fold increase in data storage density. In the second competition, ATP committed an additional \$5.5 million to NSIC, matched by \$6.2 million from industry members, to develop ultra-high density magnetic recording heads and increase data storage density as much as one-hundred fold to 10 gigabits per square inch. Recently, DARPA announced

¹Recipients of ATP grants often cooperate closely with allied research at government laboratories including NIST and a number of DoE labs such as Oak Ridge National Laboratory, Sandia, Argonne, Brookhaven, Livermore, and Lawrence Berkeley. ATP is also funding the further development of technology originating from MIT's Lincoln Laboratories (a DoD contractor-operated laboratory).

that it will provide an additional \$10 million to fund NSIC in research complementary to that being funded by ATP.

- The American Display Consortium (ADC) brings together an alliance of mostly small U.S. producers of flat-panel displays. ADC is carrying out an integrated series of research projects aimed at developing automated inspection and repair technology (essential for large-volume, low-cost display production) and advancing two generic technologies for interconnections and packaging. The results of the ATP project are applicable to the design, production, testing, and manufacture of a variety of liquid crystal, gas plasma, and electroluminescent displays.

Another important impact of joint venture collaboration is cost savings from avoiding needless redundancy of research work and duplication of equipment purchases.

- Participants in the Printed Wiring Board (PWB) Joint Venture estimate their savings from sharing equipment and dividing research responsibilities at close to \$30 million over the first year of the project. (The savings estimate is taken from an internal report by NCMS to ATP.) The PWB joint venture is developing the technology that all of the approximately 900 U.S. firms in the PWB industry must have if they are to produce PWBs capable of supporting the increasing speed and complexity of microelectronics, and maintain a competitive position in the \$25 billion world market. The joint venture is coordinated by NCMS and participants have included AT&T, Texas Instruments, Digital Equipment, Hamilton Standard Interconnect, and DoE's Sandia National Laboratory. ATP committed \$13.8 million over five years to the project, and industrial participants are providing \$14.7. DoE recently boosted the project's funding by an additional \$5 million.

The ATP is encouraging major U.S. industries to address multiple generic problem areas that are hindering their competitiveness in world markets. U.S. automotive manufacturers, for example, are demonstrating a strong recognition of their need for cooperative research by participating in three of the ATP-funded joint ventures. In the second competition, ATP committed nearly \$30 million, matched by an industry commitment of over \$40 million, to fund the following three major research efforts that promise to advance automotive manufacturing:

- The Rapid Response Manufacturing Joint Venture led by NCMS is the largest ATP-funded joint venture to date. The project addresses the problem that U.S. manufacturers as a whole trail their major foreign competitors in adopting advanced, highly integrated systems for manufacturing. The project aims to greatly shorten the time from product design to production. Company participants include Ford Motor Company, AMDC, General Motors Corp., Texas Instruments, United Technologies Corp., Aries Technology, Cimflex Teknowledge Corp, Cimplex Corp, CAD Inc, Parametric Technology Corp, and Spatial Technology Inc. DoE's Oak Ridge Y-12 Facility is also participating with DoE funding. The project, a major experiment in computer-integrated manufacturing, will use the production lines of consortium members as testbeds for experimental implementation and evaluation of prototype automated design and production systems to be developed under ATP funding.

- The Auto Body Consortium was formed to improve measurement technology and process control for part fabrication and motor vehicle assembly systems to achieve improved fit and finish of the basic body parts and subassemblies. A related goal is to improve the scientific understanding of sheet metal fabrication and assembly processes. Participants in this ATP-funded joint venture include General Motors, Chrysler, ASC Inc., CDI-Modern Engineering, Classic Design, Delta Engineering, Detroit Center Tool Inc., Efficient Engineering, Perceptron Inc., Pioneer Engineering & Manufacturing, Progressive Tool & Industries Co., and the University of Michigan, under the umbrella of the "2 mm Program." ATP has committed nearly \$5 million, and consortium members, an additional \$9 million.

- A third ATP-funded joint venture aimed at improving the competitiveness of the automobile industry is the Joint Venture on Cyclic Thermoplastic Liquid Composite Molding. Ford Motor Company and General Electric Company, with participation by Pittsburgh Plate Glass, American Leistriz, Rensselaer Polytechnic Institute, University of Tulsa, and the Industrial Technology Institute, are developing cost-effective, light-weight materials for future automobile parts that are crash-resistant and more easily recyclable, in addition to being fuel efficient. ATP has committed over \$5 million to this effort, matched by an additional \$5.5 million from Ford and GE.

Collaborations and Strategic Alliances of Single-Company Award Recipients

Many of the single-company award recipients have formed collaborative relationships with universities and federal research laboratories to strengthen their R&D capabilities. The following are examples:

- Armstrong World Industries, Inc., and the University of New Mexico.

- Saginaw Machine Systems, NIST, and the University of Michigan.
- American Superconductor Corp., and Oak Ridge National Laboratory.
- Nonvolatile Electronics, NIST, the University of Minnesota, and Iowa State University.
- X-Ray Optical Systems, Inc., NIST, and the State University of NY, Albany.
- AT&T, NIST, Brookhaven National Laboratory, and Sandia National Laboratory.

• AstroPower, Inc. and the University of Delaware.

• Bio-Eng, Inc. and the Massachusetts Institute of Technology.

The single-company award recipients (and pairs of joint-venture partners) have also formed strategic alliances with potential customers to gain early market information and clearer, faster routes to market. The following are examples:

- Nanophase Technologies (NT) has allied with Caterpillar, a potential end-user of the nanophase ceramic materials being developed.
- American Superconductor Corp., (ASC) has arrangements with Reliance Electric for experimental use in their motors of the high-temperature superconducting coils ASC is developing.
- Spectra Diode Laboratories is affiliated with Xerox, a potential user of the multiwavelength laser diode arrays Spectra is developing.
- Honeywell, Inc., is allied with Sheldahl Co., to gain feedback from Sheldahl's application to materials processing of the neural network sensor and control technology, now under development.
- Nonvolatile Electronics, Inc., has a joint program with Micron Technology, Inc., (the largest U.S. merchant manufacturer of DRAMS) to make MRAM cells for research purposes.

Some single-company award recipients have formed strategic alliances with their suppliers to ensure that the suppliers will be able to keep pace with their future needs. The following are examples:

- AT&T is working with several potential suppliers of precision optics to overcome technical barriers that threaten to impede AT&T's further progress in the area of projection x-ray lithography.
- E.I. du Pont de Nemours & Co., is working with the Kurt J. Lesker Company, a small company supplier of thin-film sputtering equipment, to ensure that the company will meet the equipment specifications that du Pont will need to fabricate advanced thallium, high-temperature, thin-film superconductors for electronic devices. As a result of this alliance, Lesker will be able to supply more advanced vacuum deposition equipment.

Promotion of Small Businesses

The ATP is directly promoting the viability of small businesses by providing R&D funds they otherwise would not have been able to obtain, by providing assistance from researchers at NIST and access to special facilities when appropriate, and also by enhancing the image of the company with potential investors and end-users of the technology.

Thirty-four of the 60 projects funded by ATP in the first two competitions are led by small businesses, while 63 of the 150 participants in all projects funded in the first two competitions are small businesses. In addition, there are many more small businesses that are subcontractors to the participating organizations. These companies have indicated that ATP funding is critical to their pursuit of the proposed technologies. The following are examples of comments received from small companies participating in the ATP:

- "What distinguishes the ATP program is that it enables creative people to propose new ideas and have them considered for funding within the broad context of a generic technology with the potential to make America more competitive in world markets. * * * Prior to the ATP program, there was no source of government funding that: 1) was open to new ideas; 2) had a view to eventual commercialization; and 3) could provide adequate levels of funding in a relatively short period of time. In my opinion, the ATP is currently the best vehicle for supporting and tapping the creativity and market knowledge inherent in the Silicon Valley and other such areas around the country." (Letter from Dr. John Ostrem, Vice President of Research & Development, Communications Intelligence Corporation, Redwood Shores, CA.)
- "NVE felt firsthand the impact of capital scarcity when attempting to obtain venture funding * * * the technology was not matured sufficiently to guarantee near-term (one to two years) producibility and profits. * * * The award from ATP to NVE in April 1991 was a Godsend to us. We are now able to address directly the practical roadblocks to making the technology a commercial success

This program is certainly vital to my company, and I believe it is a great program for our country." (Letter from Dr. James Daughton, President of Nonvolatile Electronics, Inc., Plymouth, MN.)

Employment

Sixty-five percent of the companies in the third-party interview study reported that participation in the ATP had resulted in the creation of new jobs in their organizations within the first year—35 percent said that participation in the ATP had enabled them to retain existing jobs that otherwise would probably have been lost because they were in companies hard hit by job cutbacks.

Whether newly created or retained, the jobs were high value added, and primarily for scientists, engineers, and highly trained technicians.

Shortened R&D Cycle

Participation in the ATP is speeding up the technology development process.

- 69 percent of participants in the third-party interview study reported that the ATP award had resulted in a time savings over the first year of the project in carrying out the R&D program—35 percent of these stated that the time savings thus far were critical to the success of the project.

- Single-company award recipients indicated time savings ranging from a quarter of a year up to 10 years.

- One joint-venture leader indicated a time savings equivalent to 120 person years over the first year as a result of avoiding needless duplication of research tasks among participating companies.

Achievement of Technical Milestones

All of the ATP projects that have been underway for a year have achieved important technical milestones—most of them on time, and some earlier than expected. Because technical achievements add to the nation's knowledge base, they are important outcomes in and of themselves. Since technical achievements are prerequisite to commercial achievements, they are also seen as short-to-medium term indicators of ATP's likely success in stimulating economic growth and productivity and refueling manufacturing practices. The following is an example of technical milestones achieved for the first ATP project that has been completed:

- Hampshire Instruments, Inc., and McDonnell Douglas Electronic Systems Company working together on solid-state laser technology for point-source X-ray lithography have achieved all of the technical milestones (which deal with the measurement, modeling, and control of thermal distortion in laser glasses) of their ATP-funded project. McDonnell Douglas successfully developed an array of gallium arsenide diodes capable of driving a neodymium doped garnet laser. The technology will enable flash lamps to be replaced, higher performance levels to be obtained, and provides the basis for a cost-effective X-ray stepper for use in microlithography. Hampshire is developing a research prototype photolithographic stepper incorporating McDonnell Douglas' X-ray point source and will test the prototypes at U.S. semiconductor fabrication facilities during the next year.

Protection of Intellectual Property Rights

A number of ATP awardees are gaining intellectual property right protection of their work by filing patent and software copyright applications. Others are relying on trade secrets for protection. The following quote from one awardee illustrates the typical reaction to participating companies to the ATP's position on intellectual property rights:

- "One nice thing about ATP (as opposed to other governments programs) is that it allowed us to protect proprietary information, plus we can publish what we like." (SOLOMON ASSOCIATES Study, 1992.)

Licensing of Technology

ATP participants are free to follow a variety of paths to commercialization of their technology, including licensing the technology to others while protecting their intellectual property rights. Communication Intelligence Corporation (CIC), which is developing a generic pen-based user-interface software for computers, is protecting the source codes for its software and taking an aggressive approach to licensing its generic pen-based user-interface software for computers. CIC's goal is to license the technology on a non-exclusive basis and create a standard for the world market. The company appears well on the way to accomplishing its goal:

- CIC has recently concluded a world-wide licensing and technology alliance with IBM and a major licensing agreement with NEC of Japan, which has a majority of the Japanese PC market. It has also formed licensing agreements with other U.S., Asian, and European hardware manufacturers. As a result, CIC expects to achieve

a 70 percent-80 percent share of the Japanese market for pen-based computer interface software, as well as a majority share of the European and U.S. markets. According to CIC, "The premier thing that has come direct from the ATP is its influence on achieving these licensing agreements."

Defense Conversion

ATP is getting proposals from an increasing number of defense contractors. Participation in the ATP is expected to facilitate their conversion to civilian commercial production, by providing funding and by requiring strong predevelopment business planning.

- One defense contractor commented that "while laser systems is still 90 percent DoD, the ATP program was in part pursued because it was a chance to diversify beyond just DoD procurement contract funding. * * * ATP was obviously not just another DoD procurement contract—it got a lot of attention. Department of Commerce and defense conversion were much on our minds." (SOLOMON ASSOCIATES Study, 1992.)

- Another defense contractor commented that "I've got a better perspective of the way commercial businesses operate than I did prior to our collaboration with [the joint venture partners]." (SOLOMON ASSOCIATES Study, 1992.)

- A defense systems group within a larger corporation commented that "ATP allowed us to do the technology work necessary to make our manufacturing processes competitive in the industrial/commercial sector. This is important because within (our group) we see a downsizing, and we will have less product to build in the future for the defense market. Therefore, there is an overriding need to become more competitive in. * * * commercial markets." (SOLOMON ASSOCIATES Study, 1992.)

- The Innovative Science and Technology Office of the Strategic Defense Initiative has encouraged its contractors to seek opportunities for civilian applications of technology developed by SDI. For example, SDI contracted with Cree Research to develop silicon-carbide devices for military applications. Cree also foresaw numerous civilian applications for this technology, but recognized that to compete in the civilian marketplace they needed to achieve low-cost better quality materials. This led to Cree's ongoing ATP project. AstroPower received an SDI contract to develop a new electro-optic crystal growth technology that proved very promising, but additional R&D on manufacturing technology was required in order to lower costs for civilian markets. This is the thrust of AstroPower's ATP project.

Investment in Production Capacity

ATP award recipients and their business partners are beginning to invest in plant and equipment needed to accelerate applications of their technologies to market, but more time is needed for this outcome to be observed on a wide scale.

Measuring Long-Term Economic Impacts

The fourth element of the Evaluation Plan is to measure long-term economic impacts of projects funded. The economic impact measures relate directly back to the ATP mission statement and are designed to assess the long-run success of the ATP in contributing to U.S. economic growth, industrial competitiveness, and job creation. Measures of long-run success of the program include the following: Sales and Value Added; Manufacturing Costs/Product Quality/Time to Market; Market Share; New Industry Creation; Pollution Reduction or Prevention; Health and Safety Benefits; Dual- or Multiple-Use Technology Creation; Infrastructure Benefits; Aggregate Employment Effects; International Trade Effects; and Private, Public, and Social Rates of Return.

The ATP is expected to stimulate new and improved products and processes with high value added; decrease manufacturing costs, increase yields, decrease time to market and increase manufacturing productivity; spawn entirely new industries, as well as grow existing industries; and improve the global market share and competitiveness of U.S. companies. The ATP is also expected to stimulate and speed the development of new medical diagnostic treatment tools, safer products and processes, and environmentally benign products and processes. In many cases, the technologies developed will benefit both civilian and defense applications. Benefits are expected to exceed program costs by a high margin, and rates of return on public (federal government) investment are expected to be high relative to the government's borrowing cost, federal discount rates, and private and public opportunity costs.

Because projects funded by ATP are multi-year and all are still in the R&D phase of the product/process development cycle, it is premature to assess long-run economic impacts. In most cases, it will be a minimum of several years after the ATP-funded work is completed before the technologies will be incorporated into products

for sale. Long-run economic impact measures will be developed through detailed case studies of completed projects.

[“The Advanced Technology Program—An Assessment of Short-Term Impacts: First Competition Participants,” by Solomon Associates may be found in the committee files.]

Senator STEVENS. Well, I would like to see it. But I would also like to find out if anyone inquired what was funding available in the marketplace for those activities.

Secretary BROWN. And that clearly is one of the things that we do in the process. We do not want to duplicate the availability of private funds. The things that we fund through the ATP program are things that we make a judgment would not have been able to get off the ground without some kind of public-private partnership.

If your point, Senator, is that we should not be doing things that the private sector will pick up and do by itself, I absolutely agree with you. That is one of the principles of the program.

Senator STEVENS. Well, I would like to have that demonstrated. I understand where the basic concept is going, but it does seem to me in each one of the examples you mentioned, there should have been money available in the private sector. Now, if it is a question of availability in the private sector of money generally, that is another matter.

But I should think that each one of those had moved along to the point where there ought to be private investors willing to take the risk. And instead, what we are saying is that someone in Government is going to pick and choose between those processes that are going to go forward and be subsidized in implementation, I do not think we have got money enough to do that, not if we are going to have to raise taxes to do it, that is where I am coming down to the bottom line.

This is going to increase the cost of these programs over a 3-year period at the time when we are trying to reduce spending. How do we justify that?

Secretary BROWN. Well, Senator, we are reducing spending in a number of other areas, as you know. There are many who feel—and the Congress, in its infinite wisdom, evidently felt when it first enacted legislation which included the ATP program—that we were falling behind technologically, that we were becoming second-ranked technologically. And that a lot of it had to do with the fact that there was no real coordination, communication, partnership between the public and private sector, and that there were certain kinds of new technologies that would not be explored appropriately if it were not for assistance from the Government.

And when the Congress enacted that legislation initially, I think they did the right thing. I think S. 4 is doing the right thing as well.

Senator STEVENS. Well my bottom line is I see that you have got \$18 million in the first year to be earmarked from the Defense Conversion Funds. If this is part of defense conversion, trying to move certain existing facilities into the implementation of new technology and to recreate new job opportunities for those who have been involved in the defense production that is going to be re-

duced, I can understand it. I think there is a Federal necessity for that.

But if it is to find ways to stimulate one part of the industry to expand, as opposed to the other, I do not think that is a Government role. So, I would like to have those examples and I look forward to working with you. I would like to better understand it.

I do not think that out where I come from, people are going to understand us when we say we are cutting Federal spending, oh, by the way, we just brought about a new \$2.5 billion manufacturing technology program. That is not going to help the people that are out of work in my State, and I have the highest level of unemployment in the country. And I understand what Mr. Dorgan is saying. I do not think we are going to get very many manufacturing centers in Alaska or North Dakota.

So, we have got to find some way to explain this in terms of the current psychology of cutting spending to try and reduce the amount of money we spend on interest and national debt, so hopefully some time we can spend that money for things like this. But right now, I do not see that this is consistent with what we hear both sides—and I am not being partisan. Both sides are saying we have got to cut spending, and yet this is a proposal to increase spending in the three first years of the period when we are supposed to be cutting spending. I think we have got to have a big sell on this one.

Thank you.

The CHAIRMAN. Mr. Secretary, let the record show that this is not \$2.5 billion, it is less than \$1 billion. The distinguished Senator and I serve on the Defense Appropriations Subcommittee and we have got \$38 billion in defense research and development.

Senator STEVENS. Mr. Chairman, I just read that this authorizes \$2.5 billion, and I thought it said 3 years, but it is over 2 years. For the first 2 years it says \$2.5 billion.

The CHAIRMAN. Well if you want to save the money, and I am going to help you, there is \$38 billion over there and we are trying to get it in here to get us competitive. And it is an even agreed to program by President Bush. He is the one that signed the law. We had to sneak it into the trade bill, though, I will admit that. [Laughter.]

That was the only way we got him to sign it.

Regarding the preliminary results on performance of the manufacturing and technology centers, we have the article from Cooperative Technology R&D Report. We will insert that in the record here.

[The information referred to follows:]

[The Cooperative Technology R&D Report, December 1992]

PRELIMINARY RESULTS ON PERFORMANCE OF MANUFACTURING TECHNOLOGY CENTERS—ONE MTC-HELPED COMPANY WENT FROM 0—\$6 IN EXPORTS

President-elect Clinton has endorsed the creation of 170 new Manufacturing Technology Centers (MTCs) as a solution to strengthening the US small manufacturing sector.

But are MTCs really helping small manufacturers get ahead?

Yes, and sometimes spectacularly, according to recent, preliminary data concerning the performance of selected MTCs gathered by the National Institute of Standards and Technology (NIST), administrator of the seven existing MTCs.

Though only a small sampling of the total MTC client base, over 94 percent of the companies responding to the study said their sales had increased 34 percent over the past 24 months. Net employment among the companies increased by 7 percent over the same period, and average productivity increased by 5 percent.

In its first "pilot test" to evaluate MTC performance, NIST asked MTC clients questions designed to elicit inferential MTC performance data. Participating centers were the Great Lakes MTC and the New England MTC, and a total of eighteen clients of the two centers responded.

An eighteen clients were told that "all questions refer to this [business] location during the recent 12-month period for which you have records, and the same period 2 years earlier (generally fiscal years 1991 and 1989)."

The questions and answers in the MTC client survey are as follows:

1. *For that period, what were your sales at this location? What were they for the same period two years earlier?*

17 respondents reported an average percentage increase in sales of 34 percent.

In the aggregate, respondents experienced a total increase in sales of almost \$20 million (\$19,536,000), which represents a total weighted average increase in sales of 14 percent.

2. *Approximately what percent of those sales were exported, meaning that you shipped to a customer located outside the United States? How about two years earlier?*

One company which had no export sales before the MTC engagement, jumped to \$6 million in export sales. The other 7 respondents reported an average percentage increase in export sales of 148 percent.

In the aggregate, there was a total increase in export sales of \$6.605 million, representing a total weighted average increase of 330 percent in export sales.

3. *On average during the period, what was your total employment at this location? How about the average two years earlier?*

18 respondents reported an average percentage increase in employment of 19.2 percent.

In the aggregate, net employment rose by 109 persons from 1596 to 1705, which represents a total weighted average increase of 7 percent in employment.

The average percentage increase in productivity (sales \$/per employee) was 15 percent. The total weighted average increase in productivity was 5 percent.

4. *For the same period, what was your total payroll at this location? What about two years earlier?*

13 respondents reported an average percentage increase in payroll per employee of 15.7 percent.

There was a total weighted average increase of 55 percent in payroll expenditure per employee.

In the aggregate, clients surveyed experienced a total increase in payroll of \$5,239,409, a 32 percent overall increase.

5. *During the same twelve month period, what was a representative level of total Inventory, including raw materials, work-in-progress, and finished goods at this location? How about two years earlier?*

Inventory turns increased from a total weighted average of 7.14 to 8.29 for the 14 respondents, which represents a 16 percent overall increase in inventory turns.

6. *For the same period, what was the value (or percent) of the material and parts you scrapped at this location? What about two years earlier?*

8 respondents reported an average percent decrease in scrap rate (scrap \$/per sales \$) of 32.5 percent.

In the aggregate, respondents experienced a total weighted average increase in the value of materials scrapped of 0.64 percent.

7. *Finally, approximately what percent of your employees at this location use a computer or programmable machine controller at least weekly? What was the percentage two years ago?*

18 respondents reported that the number of employees using a computer at least weekly went from 27 percent of their workforce to 46 percent of their workforce; in the aggregate, a net increase of 19 percent.

[Note: data has not been adjusted to reflect the 5.7 percent inflation over the two-year period 1989-91.]

The CHAIRMAN. Just in summary, of a sampling of the manufacturing technology centers, over 94 percent of the companies responding to the study said their sales had increased 34 percent over the past 24 months. Net employment among the companies in-

creased by 7 percent over the same period, and average productivity increased by 5 percent.

Senator PRESSLER had one question.

Senator PRESSLER. Yes. I just want to get a picture of how the decisions are made sort of—and maybe you can supply this for the record or maybe the chairman can. Now over at DARPA, which used to be ARPA when I was in the Army, I did some assignments for them out in Vietnam, but as I understand it, the Secretary of Defense makes the ultimate decisions as to what research is critical to ARPA or DARPA, or whatever they call it. Is that correct?

The CHAIRMAN. Yes.

Senator PRESSLER. Now, as I understand it, the critical industries list or the critical technologies list, that will be made up by the Secretary of Commerce basically. You will take in all the—is that right?

Secretary BROWN. In the Department of Commerce. We have not yet determined whether the Secretary will actually make those decisions. I would doubt it. I would suspect it would be made in the Technology Administration.

Senator PRESSLER. They will get the input from the White House Science Advisor. Somebody has got to decide.

Secretary BROWN. That will be one source.

Senator PRESSLER. So, it will be, basically, the Department of Commerce or within the bowels of the Department, this list.

Secretary BROWN. Correct.

Senator PRESSLER. Now, when you make up this list of critical industries, how much consultation will there be with DARPA?

Secretary BROWN. I think there will be some with the Defense Department, there will be some with the Energy Department. It depends on what technologies we are talking about. We will reach out as broadly as we can to get as much expertise as we can before making those judgments.

Senator PRESSLER. But what I am trying to get to is will there be a formal consultative role between DARPA and the Department of Commerce, or am I using the wrong term when I say the Department of Commerce?

Secretary BROWN. No.

Senator PRESSLER. Certainly, ultimately, everything in the Department of Commerce is done by you.

Secretary BROWN. Surely. But I want to—if I could make clear, Senator, we are not picking businesses at all. We are not picking individual businesses. We are picking technologies, not businesses.

Senator PRESSLER. Right, I understand.

Secretary BROWN. So, I do not want—and I think Senator Stevens evidently might have had the same impression. This whole concept of picking winners and losers, that is not what this is about.

Senator PRESSLER. But you are picking the critical technologies.

Secretary BROWN. For the future; correct.

Senator PRESSLER. For the future. That is being done by Government, in this case.

Secretary BROWN. Well, it is being done by the private sector. The ATP program, all of the ideas are generated from the private sector. They bring those to Government.

Senator PRESSLER. I am not in an argumentative mood here, but if you make up a list of the critical industries that are going to be eligible, then you are making up—then you are deciding what the new technologies that will get the research money are.

Secretary BROWN. Well, there is no list, Senator. There is no list of anything.

Senator PRESSLER. There is no list.

Secretary BROWN. No. We evaluate proposals that come in from the private sector, and on that evaluation we make a judgment then, is this critical to technological development in the future. There is no list anywhere that is made up, and the proposals that come in are weighed against the list. We evaluate each proposal.

Senator PRESSLER. But you decide what the critical technologies are.

Secretary BROWN. Well, once we have made the decision on the ATP grant proposals, then you can assume that those decisions that were made affirmatively, we have thought were critical technologies.

Senator PRESSLER. But then, I mean, you would have to have some guidelines or some selected subjects.

Secretary BROWN. Certainly, as in everything, Senator, there are some judgments made. We do the best we can to make the best, most objective judgments on what will be the most appropriate technologies for the future, which ones can be quickly commercialized, which ones provide the greatest opportunity for economic growth and job growth. So, many factors would come into play.

Senator PRESSLER. Will there be a formalized running by of those things to DARPA?

Secretary BROWN. It would depend, Senator, on what the specific proposal was. Some might not have anything to do with defense technology and therefore there would not be the necessity for communication. If there were some that we thought involved some dual-use technology or something, then it would be appropriate to have those kinds of consultations.

Senator PRESSLER. Thank you very much.

Secretary BROWN. Thank you, Senator.

Senator PRESSLER. Anything more you can provide on how the process will work, actually, from a public administration point of view.

Secretary BROWN. Yes, Senator. I think what might be helpful is we can provide information on how the process works now, because we are just really talking about expanding a process that is already there. This is not the creation of a new process. This is a program already in place.

Senator PRESSLER. So, you are going to continue pretty much the same practice.

Secretary BROWN. At an expanded level.

Senator PRESSLER. Thank you.

The CHAIRMAN. On that point, Mr. Secretary, the record should show that the S. 4 bill had passed the Senate, had passed the House, we had been in conference, we had resolved the differences in conference, and 95 percent of what is in this bill was ready to be reported out. Unfortunately, I was running for reelection and they ran me around like a rat in a maze.

Secretary BROWN. But fortunately you won, Senator. [Laughter.]

The CHAIRMAN. You are nice, but what really happened is they kept saying somebody else has got a hold, somebody else has got a hold. And it was a political hold. No one really had any objection to the bill and we were ready to send it to the President for his signature.

So, it is an established program, and with respect to DARPA, Craig Fields, who used to head it up, was one of the real big helps in here some years back. In fact, perhaps his help along that line got him dismissed, and I have recommended him for the Department of Commerce. I do not have any idea who you can get over there.

Secretary BROWN. We tried to hire him, Senator.

The CHAIRMAN. Well, he is outstanding. And there is cooperation, for example, here on this side with Senator Bingaman and Senator Nunn and others like that. We found, for example, in the Bureau of Standards some years ago we had all this technology that was backed up, but no commercialization of it.

One was the rapid acquisition of manufactured parts, the RAMP project, that DARPA in the Defense adopted, whereby they computerized the different parts and when a ship breaks down in the gulf, you do not have to wait for a year and a half to fashion a new part and everything else. You punch the computer, and in 30 days the part is manufactured and delivered and the ship is repaired.

So, it is bringing back over, then, the defense into civilian technology and helping there in its research with the advanced technology program for new technologies. And instituted and initiated, as you pointed out, by private industry. You do not sit there with a list. You sit there and catch the balls that are thrown to you. And if they are worthy and willing to put money, it is the private sector that knows where the real opportunities are. They sort of make up that list.

Otherwise, going to the Dunkel text one more time now, and a couple of things in summary here, that Dunkel text that Prime Minister Major is imploring our immediate agreement upon, section 301, Mr. Secretary, it really impinges on the Nation's sovereignty in the context. Rather than 301, you have to go to what they call the multilateral trading organization that resolves this kind of approach—to the decision of a multilateral trading organization, namely the 108 signatories.

So, we have got the President of the United States telling everybody he believes in 301 and he is going to enforce 301. If he signed GATT right now, the Uruguay Round this minute, I can tell you he has done given away his 301 and it is really taking away our sovereignty and we will have to go to the multilateral organization.

Otherwise, a specific interest that I have in textiles, as you well know, the ambassador of special trade—our representative in trade, they did a study, the STR office, and they found that there would be at least 1,400,000 jobs lost in textiles if there was a 10-year phaseout of the multifiber arrangement. They deep sixed that report. The staff had made it and they wanted to hide it, so then we could not get a hold of it.

We have got the Wharton School to make a study and they found at least 1,100,000 jobs would be lost for a 10-year phaseout. They

are the largest employer in the United States. And we are talking about jobs, the largest employer of minorities, the largest employer of women in textiles would be gone, and you would lose at least 1,100,000 to 1,400,000 jobs there.

So this GATT, the Uruguay Round, has really to be restudied. They just put on the full-court press all on get a deal, get a deal, and as you have indicated, and I really appreciate your response, that a bad agreement is worse than having any agreement.

Then to the matter of the exporter's sales price offset. Mr. Secretary, we are talking now about a dynamic Department of Commerce. We have been trying to find a dumping violation, trying to find out what the domestic price is back let us say in Tokyo. Necessarily when the product comes to the United States, all countries subtract cost, insurance, and freight. But we, in addition thereto, add on the sales, the administrative, the promotional costs under one particular approach, and then thereby add on the profits.

Now in the Smith-Corona case it says it is up to the Secretary and in his discretion, and I know you do not have your general counsel on board yet but I want your general counsel to look at that, at Smith-Corona, and look at the competition.

The competition is not international; the competition is right here in Washington. The competition really is on K Street. I can tell you where the competition is. And let us go right to the Department of Commerce itself where the competition is. All the EEC, all the Pacific Rim countries disallow the add-on in determining the domestic cost of the sales, administrative, the television promotional advertising, and profits.

Smith-Corona, as to the sales, administrative costs, and profits was the Timkin case. You have got to look at those two cases. Under the court decision, the authority is there in law, and I do not see why we should not be brought in line with our competition. Do you have a comment on that one?

Secretary BROWN. Just that, as you recognized, Senator, I do not have my full trade team on board yet. Before I recommend any changes in law, I would like to be able to have them be able to give me some counsel to see if any changes are appropriate. In the meantime, I have made a commitment to you, both in private conversations and in these public hearings, that as long as I am Secretary of Commerce you are going to see the present trade laws of the United States enforced forcefully.

The CHAIRMAN. Very good. Then with respect to Commerce enforcing the circumvention provision in the 1988 act, we have just refused to do it. For example, Brother Typewriters: they just came over and in Tennessee they have got a 14-percent domestic content, but in Europe it would be required 45 percent. And our law really is supposed to be 80 percent, but they have only got 14 percent and they just circumvented it.

Now, credit should be given to Carol Hallett, the collector of Customs. She finally got a \$2 billion violation, 52-count indictment against entities of the People's Republic of China. And she was just too aggressive in enforcing the customs law. And I am told at one time, when they were looking, of course, for a new Secretary of Transportation when Skinner went over to the White House, and they were going to get her. And, oh no, the crowd that was doing

the dumping and everything else blew her away, that lady, in about 2 days around town here. Let us be sure we enforce the circumvention provisions. The other countries do and they know they mean business.

With respect to technology financing, Mr. Secretary, I want you to look at that. We find out in industry and banking that if the bank finds out, even though it is a good loan on the face of it, that the foreign entities have targeted that particular product, they are not going to make the loan. And that has stultified any kind of real banking loans and everything else because the Government is looked upon as totally helpless.

In fact, the U.S. Government is often on the other side. In fact, in the television cases during the seventies, the Supreme Court had the comment itself, the Department of Justice appearance there was on behalf of the Japanese, not on behalf of the United States. And that is how far out it has gotten. No wonder we do not produce any televisions any longer.

So, let us look at that, because there has got to be some kind of financing plan. We had former Secretary Brown of Defense, Harold Brown, come up to testify before this committee for a civilian technology corporation, a sort of reconstruction finance corporation. They wanted \$5 billion to have it operated totally by the private sector, to get our technology financed and these new endeavors and everything else.

It was a very comprehensive presentation that attracted the attention of most of this committee. We are looking at it now. My question is since we can get a Government now that is willing to work, why not work it at the Government level. But we would like you to study that and give your comments on it.

There is another provision in S. 4 regarding the assessment of the foreign programs. I think President Clinton would have liked to have had that when he visited Boeing up there the other day, and if we had a proper assessment we would have really realized exactly what Boeing was trying to tell us.

Then foreign trade zones. We had that. They moved a little golf cart manufacturer, the Japanese did, into a foreign trade zone near Perry, GA, for supposedly 1,000 employees and put out 2,000 other workers that were paying the customs duties on the Mitsubishi engine that was going into the golf cart manufactured in Augusta and Clinton, SC. But when they put in the foreign trade zone, when they brought in the Japanese engine, they did not have to pay that so they could underprice them.

Foreign trade zones were to assemble and export, not assemble and put into the domestic market. That program has been totally adulterated. You have got them running all around. They are usually in port facilities where they go and immediately—not upon export, assemblage—they immediately export it. Now people want them all in the interior of the country and everything else for the tariff advantage. That is administered by the Secretary of Commerce and I wish you would look into that.

I have a lot of questions here I could submit to you, but I really appreciate you kicking off our hearings this year and the aggressive attitude that you have taken in the role of Commerce. If we can put this country back in business again, that will do more to-

ward creating all the jobs. I think 50 percent of our problem here may be invested in that, but the other 50 percent is a lack of the Government competing and producing up here in Washington.

Do you have any further comments?

Secretary BROWN. No, thank you, Senator. I am just very appreciative of the opportunity to be your lead witness on S. 4. I look forward to the opportunity of appearing before your committee many times in the months ahead. Thank you very much.

The CHAIRMAN. I look forward to working with you. Thank you very much. The committee will be in recess.

[Whereupon, at 11:41 a.m., the hearing adjourned.]

S. 4, THE NATIONAL COMPETITIVENESS ACT OF 1993

THURSDAY, MARCH 25, 1993

U.S. SENATE,
COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION,
Washington, DC.

The committee met, pursuant to notice, at 10 a.m. in room SR-253, Russell Senate Office Building, Hon. Ernest F. Hollings (chairman of the committee) presiding.

Staff members assigned to this hearing: Patrick H. Windham, professional staff member; and Louis C. Whitsett, minority staff counsel.

OPENING STATEMENT OF SENATOR HOLLINGS

The CHAIRMAN. The committee will please come to order. Let me explain our dilemma. There was an old song about somebody's rocking my dreamboat, I'm captain without any crew. That is the song today.

What occurs is under our Budget Act that we passed back in 1974 there are 50 hours for debate on the budget resolution, and thereafter, when the 50 hours are exhausted, we vote around the clock on amendments without debate until a time certain, if one can be determined.

One has been determined. At 12 noon, 2 hours from now, we will have a final vote irrespective of amendments, but between now and 12 noon it is just chaos. You cannot get the Members here.

We cannot really listen to the witnesses, and yet they have traveled from all out of town here except a couple, Dr. Prestowitz and of course Senator Bob Kerrey of Nebraska was to lead off the witness group.

What I am going to try to do is just call it off this morning, because I am running out of time fast. The bell is going to ring again and I will have to run back down. I cannot control it, and there are going to be votes every 10 to 15 minutes, all morning long.

With that in mind, we are going to ask the witnesses who can stay to come back at 2 p.m. I will just have to cancel out all what we had. This afternoon there is a debate on the President's stimulus package, and I can see more extended debate rather than up-and-down votes.

So, if you are from out of town and still have a plane scheduled that allows you to come in here at 2 p.m., as a courtesy for your inconvenience and endeavor to inform the committee, I will be here at 2 p.m. and cancel out what I have and listen as long as I can.

In the meantime, irrespective of what occurs this afternoon and how many witnesses can remain long enough to testify, we will accept statements of all the witnesses and make a complete record.

There is no other way that we can handle this, because I can tell you, trying to find even another time will be difficult. Yes, we can begin tomorrow, and I know we are going to have votes on Monday, and we might start a series of around-the-clock votes and tell you to come back a second time and inconvenience you then, and then ask you to come back again, and you say, they do not know what they are doing, and you are right, we do not know what we are doing except for the situation of trying to hear you and complete this record on S. 4.

So, we are going to ask the witnesses all to file their full statements. We will make a full record, and I will cancel out my afternoon appointments and see if I can find some other members of the committee here to hear you this afternoon, because there is nothing else we can do. That bell will ring here again in a few minutes and we will have another rollcall.

Are there any suggestions? Does anybody have a comment? Other than that, thank you very much. The committee will be in recess until 2 p.m.

[Whereupon, at 10:15 a.m. the committee adjourned until 2 p.m. this same day.]

AFTERNOON SESSION

The committee met, pursuant to notice, at 2 p.m. in room SR-253, Russell Senate Office Building, Hon. Ernest F. Hollings (chairman of the committee) presiding.

Staff members assigned to this hearing: Patrick H. Windham, professional staff member; and Louis C. Whitsett, minority staff counsel.

OPENING STATEMENT OF SENATOR HOLLINGS

The CHAIRMAN. The committee will please come to order. We appreciate all of the witnesses' indulgence and understanding. If Mr. George Brooks on behalf of the National Coalition for Advanced Manufacturing and Mr. Brian Carlisle of the American Electronics Association, could come forward, please, I will enter an opening statement. Well, wait a minute, here is Clyde, and you all just keep your seat at the table, and Mr. Clyde Prestowitz has a 2:30 appointment here, and I want to try to get him to that.

Mr. PRESTOWITZ. Actually, I have a little bit more time, Mr. Chairman. They pushed it back to 3 p.m.

The CHAIRMAN. Well, you have two good lawyers on either side of you, so if you do not know the answer, you can refer to them. [Laughter.]

The CHAIRMAN. I was just thanking all of the witnesses for their understanding. My opening statement and all the statements are in the record.

[The prepared statement of Senator Hollings follows:]

PREPARED STATEMENT OF SENATOR HOLLINGS

Good morning, and welcome to this committee's second hearing on S. 4, the National Competitiveness Act. We held our first hearing on February 24, when we

heard from the Secretary of Commerce. This morning we will hear from a distinguished group of industry leaders and technology experts.

S. 4 has two main purposes. First, it significantly upgrades the technology and manufacturing programs of the Department of Commerce, in order to help U.S. industry to improve competitiveness and create jobs. Second, it contains Vice President Gore's proposal to support industry's research efforts to develop advanced computer technologies and applications—technologies and applications that will help companies make more efficient use of the Nation's private telecommunications networks.

As I have said before, technology has never been more important to the Nation's future. Americans know that we must become more competitive in this postcold war world, and that staying ahead in technology is vital to our jobs and our prosperity.

The provisions in S. 4. are particularly timely. On February 17, the President addressed Congress on the economy, and issued an accompanying report that proposed significant increases for civilian technology programs, particularly those DOC programs which support industry's efforts to stay at the cutting edge of technology. The President proposed for fiscal year 1993 a supplemental appropriation of \$103 million for DOC's Advanced Technology Program, and proposed that the overall budget of DOC's National Institute of Standards and Technology rise to \$1.2 billion by fiscal year 1997, from the current fiscal year 1993 level of \$384 million. Then on February 22, the President announced a far-reaching technology policy which, for the first time, made economic growth and jobs among the highest priorities for Federal science and technology policy. A sea change is underway in Federal research policy, and civilian technology will no longer be a stepchild. In my view, S. 4 can play an important role in advancing these new economic priorities.

As we begin this hearing, I repeat two key points I made at the start of the committee's February 24 hearing. First, we must ensure that the Federal Government's \$70 billion annual research budget is made more useful to U.S. industry. At a time when other countries continue to help their firms, and when long-term investments in new technologies can pay huge economic dividends, the Government has a major responsibility—to support industry's own efforts to speed the commercialization of new technologies, improve manufacturing, and save jobs. Just as the land grant Universities and agricultural extension helped the United States to become the world's leader in agriculture, support for industry-led research and for manufacturing extension can help to restore prosperity and growth to U.S. industry.

Second, as important as it is, good technology is not enough by itself to ensure U.S. competitiveness and prosperity. Other steps are equally vital, and here too DOC has a crucial role to play. We need, at a minimum, strict enforcement of the U.S. trade laws, particularly the antidumping statutes. Good technology will not be enough if others are allowed to use predatory pricing to wipe out American companies. We also must create the right financial climate. We must begin by controlling the Federal deficit. Then we must add the right incentives, such as an investment tax credit and perhaps other forms of financial assistance. Finally, we need to be creative—to use new thinking—about other ways in which Government can help. For example, we should free radio spectrum so that private industry can develop new wireless communications technologies. In short, there are many important factors that contribute to U.S. global competitiveness, and none can be ignored.

The Commerce Committee will be active this year, not only on technology policy but also on competitiveness in general. S. 4 is vital, and the committee will proceed on it expeditiously. In addition, the committee will continue to work on other competitiveness issues, looking, for example, at key industries to see how Federal technology policies and other policies can promote U.S. competitiveness and jobs. In this regard, the Clinton administration has already mentioned sectors such as advanced manufacturing, aerospace, and automobiles. The Commerce Committee will continue to be a leader in examining and proceeding to action on these issues.

I am pleased that we have such impressive experts to testify at today's hearing. We will begin with testimony from our good friend and colleague, Senator Kerrey of Nebraska, who will speak on the importance of improving computer technologies and applications. Next, we will hear from four leaders on technology and manufacturing policy. Dr. Robert White, president of the National Academy of Engineering, and former administrator of the National Oceanic and Atmospheric Administration, is one of the Nation's respected experts on technology policies that can help industry. Mr. Clyde Prestowitz, president of the Economic Strategy Institute, is known to all of us and is a leading spokesman for sound governmental trade and competitiveness policies. We also will hear from two top corporate leaders speaking for two major industrial groups, the National Coalition for Advanced Manufacturing and the American Electronics Association. The second panel contains distinguished wit-

nesses from around the country who will speak on manufacturing extension, technology innovation, and computer networks.

I am particularly pleased to have Bill Siegendorf from Columbia, SC, before the committee today. Mr. Siegendorf's company has worked closely with a DOC-assisted manufacturing technology center in South Carolina, and can testify first hand to the benefits of cooperative programs between the Federal Government and private industry that promote the commercialization of new technologies.

I look forward to the testimony of all the witnesses today.

The CHAIRMAN. And Mr. Prestowitz, we welcome you on behalf of the committee, and you can deliver your statement or highlight it as you wish.

STATEMENT OF CLYDE V. PRESTOWITZ, PRESIDENT, ECONOMIC STRATEGY INSTITUTE

Mr. PRESTOWITZ. Thank you very much. I appreciate being invited to testify, and I will submit my full statement later. Let me just open with a few quick points.

Despite the current recovery of the American economy and despite the recovery of some important industries like the U.S. semiconductor industry and parts of the U.S. auto industry, the overall situation for U.S. technology and manufacturing continues to be one of steady erosion.

We see a situation in which American scientists win the Nobel prizes, American engineers are noted for developing new technology, but the commercialization of the technology continues to move offshore and to take place in other countries.

Recent reports from the Department of Commerce, from the private Council on Competitiveness, from the European Commission, and from Japan's Ministry of International Trade and Industry, are all in consensus on the view that with regard to the 24 or 25 key technologies of the 21st century the United States is losing ground across the board in all of them, maintains leadership in a few, but even in those where we maintain leadership the U.S. position is continuing to erode.

I believe there have been two primary causes for this. One of them has been the philosophy so well summarized in a statement denied by President Bush's Chairman of the Council of Economic Advisors, but you know it very well, Mr. Chairman—potato chips, computer chips, what's the difference, they're all chips.

This was a philosophy which drove domestic and international trade and technology policymaking, and it essentially was a philosophy that subordinated U.S. technological and economic interest to larger geopolitical objectives.

A second major factor behind the erosion of U.S. leadership and technology has been the emphasis in the United States on strictly military technology, and this dates back to the 1960's—the Mansfield amendment, which specifically directed the Defense Department to focus its technological development expenditures on strictly military technology and a result of that has been that we have had a department of the Government spending more than one-half of the technology dollars that we spend as a Nation primarily on things that we put in holes in the ground and hope that we would never use.

We began to lose the spinoff effects that we had from military technology in the fifties, forties, and the early 1960's, and as a re-

sult, not only did the Defense soak up an enormous part of our overall technological resources, but it allocated them in ways that were not commercially optimal.

I believe that we are now at a point where that is all changing. We have a new administration which clearly does not believe that potato chips and computer chips are the same thing, and we have a new administration which is concerned about rebalancing the U.S. R&D resource expenditures, shifting resources so as to foster greater development of commercial capabilities, and diffusing those through the economy, so that it is not just the large corporations that are the beneficiaries of this technology development but also the small- and medium-size companies.

I think that in discussing the question of how that can best be done, there are two or three critical examples. One of them is the Defense Advanced Research Projects Agency, which we are all familiar with, which has perhaps the world's best record as a venture capitalist in investing and in promoting development of new technologies and seeing to it that these technologies are diffused and commercialized.

That model is one not of large expenditures, but of careful analysis of market and technological developments and the use of Federal funds to reduce risk and to invest in technology which private venture capitalists are reluctant, because of the high risk, to pursue.

It is also a model which puts a premium on cutting across the various sectors of the Government and the economy. One of the most powerful things that DARPA does is simply to convene meetings to bring together in one place people who normally do not talk to each other so as to get the synergies and the spinovers and spillovers and spilloffs that would not occur without the convening power of the Federal Government.

Third, it performs a vital function in seeing to it that new technologies are broadly diffused and provide the maximum bang for the buck to the U.S. technological base.

A second model is the Sematech model, which I believe has had a large role in the resurgence of the U.S. semiconductor industry, and again I think one of the powerful aspects of the Sematech model is the convening function, the emphasis that Sematech has laid upon the linkages of industry.

In looking at the fate of the semiconductor industry, Sematech has realized that it is directly linked to the fate of the equipment and materials and chemical industry that supply the semiconductor industry, and by building ties between those industry sectors by reducing the risk of investment in those industry sectors, it has created new webs of synergy and technological development.

The second thing that Sematech did was to insist that private industry put up its own money. That is, it is not just a Government donation. The private industry players also have to contribute, thereby assuring that there is some real level of private industry interest and capability for diffusion of the technology later on.

I think that in this context the development of NIST, the expansion of its funding, the programs of the Advanced Technology Program of NIST, are very much in consonance with these two models, and to the extent that they are more focused on developing ena-

bling technologies and on commercialization, I believe that NIST deserves to be expanded and to be strongly supported.

I would also say there are two other aspects of any technology policy, or aspects without which you cannot have a technology policy. You can have the best technology policy in the world, but if you do not have a coherent trade policy, the technology policy by itself will not do you any good.

If you are helping to develop an aircraft industry or a semiconductor industry, and as a result of your trade policy or lack thereof you find that your market is open and other markets are not, you find products being dumped in your market, you find foreign governments heavily subsidizing their industry, it is going to be very difficult to achieve success in the technology policy unless you have a complementary and coherent trade policy focused on results, focused not on protection but focused on achieving equal conditions of competition so that entrepreneurs can in fact realize the benefits of their comparative advantage.

Finally, you can have the best production and the best technology and the best trade policy in the world, but you know, if you do not have roads to enable the trucks to get your products to the port, if the ports are all silted up, you are not going to realize the benefits of those policies.

To use a more modern analogy, if the telephones do not work, if your data communication is one-half the speed of your competitor's data communication, the rest of your policies will be in vain.

It is therefore absolutely critical that a U.S. technology policy be complemented by an infusion of the most advanced technology into our basic infrastructure.

Thank you very much.

The CHAIRMAN. Very good.

Because there are a lot of witnesses here that have to meet other appointments, I am going to hear from all three of you and then we will have a few questions and then yield to our distinguished colleague from Nebraska.

Mr. Carlisle from the American Electronics.

STATEMENT OF BRIAN R. CARLISLE, CHAIRMAN AND CEO, ADEPT TECHNOLOGY, INC. ON BEHALF OF THE AMERICAN ELECTRONICS ASSOCIATION

Mr. CARLISLE. Mr. Chairman and members of this distinguished committee, my name is Brian Carlisle. I am the founder and chief executive officer of Adept Technology. We are the manufacturer of assembly robots and machine vision systems.

I am also the president of the U.S. Robotic Industries Association, and currently I am serving on the Technology, Manufacturing and Infrastructure Committee of the American Electronics Association.

I am appearing here today as a representative of the American Electronics Association.

I have several broad recommendations for this committee. It is crucial that Government and industry work together to provide leadership in the area of manufacturing excellence by stressing the importance of manufacturing to our national well-being instead of, for example, talking about being a service economy, we send a very

important message to our students, teachers, factory workers, and business managers. An example of effective Government leadership in manufacturing is the Malcolm Baldrige Quality Award. This sort of recognition of the importance of quality control has helped motivate industry to accelerate improvements in quality. It has provided a very high return on the funds spent on it.

Next, I believe we must drastically improve the quality of manufacturing education in the United States. We must do this not only for students, but also for existing employees. We need curriculums which start with manufacturing basics such as quality control and cycle time reduction and extend to the implementation of advanced manufacturing technology such as robotics and machine vision.

We are not doing a good job in this area. Frankly, I am not sure our Government and universities have a good vision of what is needed. I would like to suggest that Government do some benchmarking in conjunction with industry to develop profiles of effective manufacturing education curriculums. One industry example which I feel is worth emulating is Motorola University.

An important element in manufacturing education is access to equipment. Just as we cannot learn to drive a car by reading a book, our factory workers and students need hands-on access to machine tools, robots, and vision systems. We need to develop innovative ways to provide students with equipment access at a reasonable cost.

Third, I believe we need an infrastructure which supports basic research, applied research, deployment, sale and application of manufacturing, and other critical technologies. Much of S. 4 is directed at this, and AEA has made many detailed suggestions on S. 4 in a written statement.

Underlying our comments are three common themes. These are, first, the absolute necessity of private sector input to all Federal technology and manufacturing programs. Industry should have a seat at the table.

Second, the critical importance of a coordinated approach to national policies and programs. Companies, especially small business, usually do not have the money or time to deal with diverse programs departments and agencies currently involved in technology and manufacturing.

Third, the need for program structures which enable rapid decisionmaking and minimize paperwork, delays, and bureaucracy.

I would like to say a few words about technology financing. For the last 5 years we have seen an alarming and growing inability of American entrepreneurs to obtain seed and venture funding. Institutional venture capital disbursements in new developing companies have fallen from \$4 billion in 1987 to \$1.4 billion in 1991.

Equally important, informal investors who commit some \$50 billion per year to small growth companies have also dramatically reduced their venture investments. What this means is that American startups are too often unable to take their ideas out of the garage and into the marketplace.

The startup financing required for a technology company to commercialize and new idea usually involves sums of several million dollars. It is beyond the scope of most individual investors, and has

been almost exclusively provided by the venture capital community.

Not only has venture capital financing fallen in total, but venture financing of manufacturing technology companies has almost disappeared. The proposed S. 4 venture capital funding of \$105 million, which might seem small even compared to the \$1.4 billion invested by venture firms in 1991, would in fact provide several times the 1991 funding of industrial products companies that were—if it were all invested in that area.

I believe the mechanism by which this financing is administered will be critical to the success of this program. AEA endorses the idea proposed in S. 4 of licensing critical technology investment companies to administer these funds. The time period for decision-making must be on the order of 2 or 3 months.

It is very important that the entire investment decision be made by the investment company. The Government should not review investment decisions, nor should it require extensive paperwork to be filed. The Government should provide oversight in the same way limited partners provide oversight to the investment companies through annual meetings, and the periodic decision to create or not create a new fund.

Finally, as we look to fund manufacturing technology development and deployment, I would like to caution the committee and our agencies against a preoccupation with computing. The AEA is strongly in favor of computing. We sponsor the high-performance computing and communications consortium. Computing and software are critical to our future economic competitiveness, but factories need a broad cross-section of equipment besides computers. We have fallen far behind Japan and Germany in machinery design, actuator technology, and sensor technology. We tend to avoid application research. As we look toward the future, we must try to regain lost ground in the manufacturing equipment industries while we retain our excellence in computing technology.

Thank you for the opportunity to present our views.

[The prepared statement of Mr. Carlisle follows:]

PREPARED STATEMENT OF BRIAN CARLISLE

Mr. Chairman and members of this distinguished committee, my name is Brian Carlisle. I am the Founder and Chief Executive Officer of Adept Technology, Inc., a manufacturer of assembly robots and machine vision systems. Adept has sales of around \$40 million and 260 employees. We are the last U.S.-owned industrial robot company with sales greater than \$5 million. I am also the President of the U.S. Robotic Industries Association. I have served as Co-Chairman of the Automation Forum (an educational branch of NEMA, the National Electrical Manufacturers Association) and on the Computer Science Review Board for the National Science Foundation. Currently I am serving on the Technology, Manufacturing and Infrastructure Committee of the American Electronics Association. I appear before you today as a representative of the AEA.

ABOUT THE AMERICAN ELECTRONICS ASSOCIATION

The AEA is the nation's largest electronics trade association, representing over 2,700 companies in the electronics and information technology industry. The voice of the industry for over 50 years, AEA has an active grassroots network of 17 councils in all key U.S. high-technology centers, as well as offices in Tokyo and Brussels. AEA member companies are all based in the U.S. and span the breadth of the electronics industry, from silicon to software to all levels of computers and systems integration. The giants of the electronics industry are AEA members. At the same time, almost 70 percent of AEA members are small to medium-sized entrepreneurs with

less than 250 employees and less than \$50 million in annual sales. The AEA also has recruited 60 of the nation's top engineering research universities as associate members to foster closer working relationships between industry and academia.

In addition, the AEA sponsors two broad-based coalitions—the High-performance Computing and Communications Consortium and the Advanced Technology Coalition—which enable numerous industry sectors, labor, academia, and professional societies to work together to advance the HPCC Initiative and critical technology and manufacturing programs.

INTRODUCTION

Mr. Chairman, I very much appreciate the opportunity to contribute to your hearings on S. 4, the National Competitiveness Act of 1993. The Committee is to be commended for developing a relatively comprehensive bill that, if properly implemented and adequately funded, will help improve the quality and rate at which U.S. companies turn ideas into globally competitive products. The authors of S. 4 have demonstrated an understanding of the importance of developing an infrastructure which supports research, development, deployment, application and sale of manufacturing and other critical technologies. If the U.S. is to achieve sustained long-term growth, high employment levels, a rising standard of living, and sustain a sufficient national defense, U.S. industry must regain world leadership in all phases of the product cycle.

Underlying AEA's detailed comments on S. 4 are three common themes:

- The absolute necessity of consistent and broad-based private sector input to all federal technology and manufacturing policies and programs. Industry should have a seat at the table.
- The critical importance of a coordinated and integrated approach to national policies and programs. Companies—especially small ones—usually do not have the money or time to deal with diverse programs, departments and agencies currently involved in technology and manufacturing.
- The need for program structures which enable rapid decision making and minimize paperwork, delays, and bureaucracy.

ELECTRONICS MANUFACTURING

Let me place my remarks in context, and explain the significance of crafting programs and policies which support the diverse and far reaching manufacturing services and information industry foodchain of electronics-based economic activity. Electronics manufacturing, the largest manufacturing employer in the U.S., faces serious challenges. In the next two decades it will be one of the highest growth industries in the world. Competition on a global level will force rapid changes in methods and strategies. There will be increasing demands for higher skill levels for industry workers. Unfortunately, the ability of the U.S. to compete in this industry at world cost and quality standards has deteriorated significantly over the last several decades. Listed below is a sample of products that can no longer be competitively manufactured in the United States:

Products we can't make at world cost in the United States

[Dollars in billions]

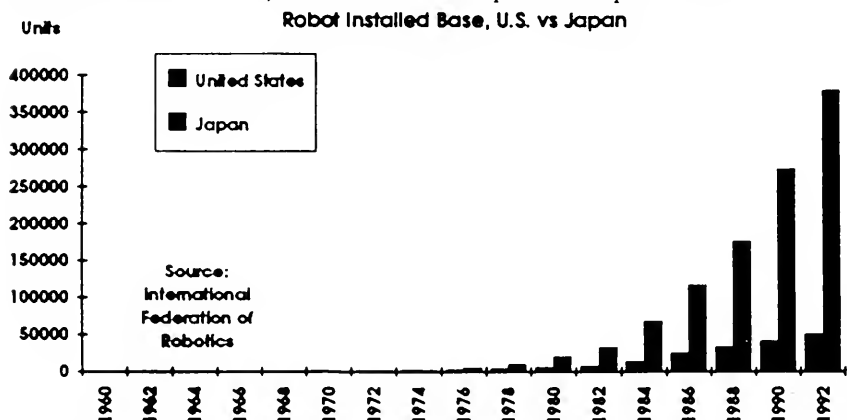
Example product	U.S. market
VCR	\$10.7
Camcorders	2.8
Portable audio	2.1
Audio	4.3
Disk drives	16.0
Total	36

So why does any of this matter?

Look at the common characteristics: these products are precision electro-mechanical or electro-optical products; they require either low-cost, skilled labor or precision automation. If one looks at the manufacturing flow for disk drives, for example, most manufacturing by U.S. disk drive companies is either done in Singapore by low-cost (\$1.50 per hour) labor or subcontracted to Japanese companies such as MKE (which builds disk drives for Quantum, a \$2 billion U.S. company). The Japanese cost of labor is similar to that in the U.S. However, Japan uses precision automation to build all these products at world cost. Japan is years ahead of the U.S. in the application of automation technology.

Our competitors either have the low-cost, skilled labor or automation. If the U.S. is to regain manufacturing pre-eminence in electronics, we must capture global leadership in the development and deployment of manufacturing technologies. (See addendum #1 for an illustration of how electronics drives product and process improvement in other sectors).

The U.S. has fallen badly behind our international competitors in adopting new manufacturing technologies. A study by the National Center of Manufacturing Sciences found that, on average, it takes about 55 years for a new manufacturing technology to be fully utilized in the U.S. The average period in Japan is 25 years. This disparity is graphically illustrated by the relative adoption rates in the U.S. and Japan of the industrial robot. The robot is one of several manufacturing technologies that have allowed Japan to control consumer electronics manufacturing. Invented in the U.S. in 1960, the first robot was exported to Japan in 1968.



While a substantial part of my statement will be devoted to technology financing, I want to take this opportunity to share with you the AEA's comments on several other provisions of S. 4.

TITLE II MANUFACTURING

The AEA fully supports the intent of Title II. The sponsors of S. 4 have crafted programs that promise to provide U.S. industry (especially small and medium-sized companies) with manufacturing assistance and accelerate wide-spread adoption of advanced manufacturing technologies. The following are comments and observations on various provisions of Title II.

Particularly noteworthy is: the emphasis on interaction and information sharing among manufacturing and technology organizations; and the requirements for extensive industry input in the establishment and operation of the Twenty-First Century Manufacturing Infrastructure Program and its Advanced Manufacturing Technology Development Program and National Manufacturing Outreach Program.

The Technology Extension Communications Network to be established under Title II to support manufacturing efforts should be used more generally to execute other activities authorized in the bill. The Commerce Department should capitalize on the network by using it to disseminate a variety of useful data and information, including benchmarking activities and work products of the Technology Monitoring and Competitive Assessment Office authorized under Title III.

The Association believes it is important for the Commerce Department to develop mechanisms to evaluate the effectiveness of the Twenty-First Century Manufacturing Infrastructure Program. We recommend that the Commerce Department look to its own Baldrige National Quality Award Program. The criteria and principles of the Baldrige Award could be used in evaluating the delivery of the Program's service to the business community.

With respect to the technology development testbeds, we are pleased that the Commerce Department is directed to consult with industry and other parties prior to making these awards. It is not clear, however, what mechanism or allocation of funding will be applied to select the testbed(s) or the development projects. The bill should provide greater clarity on these important issues.

NATIONAL MANUFACTURING OUTREACH PROGRAM

The AEA is very much in favor of the idea of manufacturing outreach and technology transfer centers which help U.S. manufacturers learn about and adopt world-class manufacturing practices and technologies. The AEA supports the approach taken in S. 4 of not assigning a fixed number of Manufacturing Outreach Centers, drawing the parameters for designation as an MOC widely, and requiring MOC awards to be competitive and merit-based. We fully support the bill's emphasis that the establishment and management of such centers should be driven by the needs of industry at the local and regional level. If the flexibility in the Outreach Program is retained as described in the bill, it will foster an entrepreneurial approach within communities taking advantage of the Program. Efforts should be made to track the various approaches taken so that regions and communities around the country have models to follow.

With respect to the Regional Centers for the Transfer of Manufacturing Technology (MTC), there appears to be a very limited vision of what the Centers should and can do. This coupled with the fact that the Centers have very small budgets and are primarily targeted at small metal-working companies, has limited the Centers ability to contribute to the U.S. electronics industry's manufacturing competitiveness.

AEA suggests that a benchmarking activity be undertaken to determine the characteristics that will allow both the outreach centers and the MTCs to have a real impact on U.S. manufacturing. For example, Motorola, at its Galvin Training Center, has spent over 10 years carefully developing and refining a manufacturing curriculum which it feels addresses its manufacturing education needs. Other U.S. manufacturing companies have similar training programs which could serve as pro to types for manufacturing outreach centers. Both Japan and Germany have their own centers which could be evaluated.

Another issue to consider is the role centers should play in manufacturing education. A major shortcoming of our U.S. manufacturing education system is the almost total lack of student access to advanced manufacturing equipment. Neither our universities, technical schools, two-year colleges, or manufacturing outreach centers provide the inquiring manufacturing engineer the opportunity to actually try out advanced manufacturing technologies like industrial lasers, Computer Numerically Controlled machining centers, robots, machine vision systems etc. Regional centers might be established along the teaching factory concept to provide this access. Equipment in these facilities should be leased from vendors to keep it current; no equipment should be older than 5 years.

PRIVATE SECTOR INPUT

The AEA strongly supports the establishment of mechanisms for formal private sector input to the federal government on policies and programs to improve industrial productivity and technology development and application. The sponsors of S. 4 are to be commended for requiring OSTP to establish an "Industry-Led Manufacturing Advisory Committee." Providing the government with industry advisory expertise on manufacturing issues is essential to the success of the activities and programs authorized in this bill. It would be helpful, however, if the Committee addressed the issue of how the Manufacturing Advisory Committee will relate to other existing or proposed advisory committees, including the Commerce Technology Advisory Board authorized under Title III of S. 4.

We recommend that the Committee consider giving the Commerce Technology Advisory Board a role in providing advice to the Twenty-First Century Manufacturing Infrastructure Program and the Advanced Technology Program. To strengthen both the Manufacturing Advisory Committee and the Board, we also suggest that membership be rotated periodically and that the Board also be required to provide specific, annual "deliverables" to the Commerce Department and the Congress.

Finally, we recommend that the Committee ensure that the missions and activities of current and future advisory entities—including the President's Council of Advisors on Science and Technology, the Manufacturing Advisory Committee, the Commerce Technology Advisory Board, and the Critical Technologies Institute—are all carefully coordinated. The AEA believes it is important to ensure that private sector input on these and other technology policy issues are well-coordinated and consistent with the broader national agenda—and not limited to the agenda or mission of the federal agency to which they report.

WHO'S RESPONSIBLE FOR MANUFACTURING

Unlike last year's version, H.R. 820 does not assign the Department of Commerce as the "lead agency" with responsibility for achieving the bill's goal of improving the competitiveness of 21st Century U.S. manufacturers. It may be implicit in the activities the Commerce Department is authorized to undertake, but there is some concern that the continuation of diffused responsibilities may inhibit the fulfillment of the intent of the legislation (i.e. maximum coordination and integration of federal manufacturing/technology efforts). A clear distinction of roles and responsibilities may still be warranted.

Furthermore, the AEA strongly urges Congress to consider supporting a long-term, coordinated national initiative (and cross-cut) aimed at advancing U.S. industry's global manufacturing competitiveness. In June 1992, the Federal Coordinating Council for Science, Engineering, and Technology (FCCSET) approved a proposal for an "Advanced Manufacturing Initiative" (AMI), a long-term, federal manufacturing budget initiative. While the AEA recommended that extensive changes be made to the proposal, the Association strongly supports the creation of a national manufacturing initiative to focus and improve the utility of federal agencies' manufacturing activities.

The AEA has strongly urged President Clinton to adopt a long-term national manufacturing initiative which is industry-led, driven by national goals, and contains coordinated and accountable federal efforts. Such an initiative should have three key elements: 1) generic technology development and deployment; 2) education and worker training; and 3) financial incentives. In addition, the AEA has recommended that some form of structured industry input is needed to guide federal manufacturing efforts. A copy of the AEA's initial recommendations on the proposed AMI will be provided to Members of the Committee.

NATIONAL SCIENCE FOUNDATION RESPONSIBILITIES

The AEA fully supports the provisions in S. 4 to increase the funding for the National Science Foundation in the areas of manufacturing research. The AEA recognizes the potential of such programs as the Engineering Research Centers Program and the Industry/University Cooperative Research Centers Program to advance useful cooperative R&D efforts. To increase their utility, however, all ERC and IURC proposals should be developed in conjunction with industry and all Centers should maintain strong industry involvement.

Also important is the establishment of new manufacturing traineeships and fellowships for graduate students who choose to pursue masters or doctoral degrees in manufacturing engineering, and the creation of the "Manufacturing Managers in the Classroom Program" to foster cooperation between industry and two-year colleges. The AEA recommends that the latter program be expanded to include qualified vocational schools.

S. 4 appropriately notes that the U.S. is no longer the world leader in manufacturing technology. Therefore we should expand funding for international study and tours, especially in Japan, for manufacturing students. NSF has had severe restrictions placed on travel funds for both students and staff. As you can imagine, the first-hand exposure which international travel provides is invaluable to the learning process. Dr. Toshio Fukuda, Professor in the Department of Mechano-informatics and Systems at Nagoya University, Vice President of IEEE Japan, Chairman Robotics and Automation Society, Chairman Neural Network Council, has complained to me that he invited 20 U.S. students to come to Japan on a tour to study robotics and had to visit NSF twice to plead for funding to support them. We should be establishing international fellowships with people like Dr. Fukuda.

TITLE III CRITICAL TECHNOLOGIES—THE ADVANCED TECHNOLOGY PROGRAM

The Association strongly supports the planning requirement and increased authorization for the Advanced Technology Program. The planning requirement acknowledges that many issues need to be hammered out and gives industry a de facto opportunity to be involved in the dialogue. A robust, thoughtful planning, management, and evaluation process will be critical to NIST's ability to absorb funds at the growth rates projected in this bill and in the Administration's plans. Fast growth provides historic opportunities; it also could bring substantial risk if not managed carefully.

The ATP should have annual funding levels of at least \$250 million to begin to meet industry needs for pre-competitive technology development assistance. The ATP should continue to be evaluated to ensure that it is adequately addressing the needs of high technology small businesses, customer-supplier relationships focusing

on small businesses as viable suppliers of new technologies, and the nation's critical technologies.

We also support the program to provide large-scale industry-led R&D consortia grants, and the mandated independent technical review of these grants. A major concern of AEA's, however, is that the program needs to be protected from political tampering. Congressional "earmarking" of funds for special districts or pet projects detracts from the overall credibility of the National Competitiveness Act and will, over the long term, most certainly serve to undermine the credibility of the federal government's objectives in this area and erode support for a more activist government role in technology support.

TECHNOLOGY MONITORING AND COMPETITIVE ASSESSMENTS

The AEA supports greater Government involvement in technology and product monitoring. U.S. companies have great difficulty obtaining timely information to make decisions more quickly than our foreign competitors. It will be helpful for companies to have access through the Commerce Department to a wide variety of information and analysis of foreign R&D activities and technical capabilities. The Committee should require rapid translation of selected publications, which would greatly assist in providing U.S. companies with timely information. In addition, the Committee should clarify how the Commerce Department efforts will coordinate with the comparative analysis done by other agencies, such as the Department of Defense and the Central Intelligence Agency, among others.

The AEA also is very supportive of creating a Technology Fellowship Program. The Committee should consider including a requirement that the fellows have significant industry experience, and expanding the Program to include joint industry/government funded fellowships.

TITLE IV QUALITY

Missing from S. 4 are provisions included in last year's competitiveness legislation that establishes a new "National Quality Laboratory" at NIST to assist and work with the private sector in setting up quality programs and adopting quality practices. There is a significant need for these activities. The Committee should consider reinstating the NQL provisions and require the Lab's activities to be coordinated with those of the National Quality Council (created by the American Technology Preeminence Act, PL 102-245). Furthermore, we recommend that the Lab be directed to serve as an integrating force for national efforts—both public and private—to raise quality awareness and deployment.

The AEA believes that the Malcolm Baldrige National Quality Award Program should remain focused on industry. Establishing quality awards for educational institutions has merit and should be accomplished through a separate program.

And, finally, the American Workforce Quality Partnerships Program appears to be a good vehicle for helping small companies establish total quality management programs. We recommend that the National Quality Council also have a coordinating role in this program, and a contributing role in virtually all other Commerce Department manufacturing programs.

TITLE V—AUTHORIZATIONS FOR NIST

The U.S. has for many years been the world leader in basic research. However, we have neglected the area of applied research - research which may see commercialization in the 3-7 year time frame—other than for military and space applications. While we have languished, Japan has excelled in this area. In robotics alone, the Ministry of International Trade and Industry (MITI) has provided hundreds of millions of dollars to support robot application development in electronics, textiles, construction, hazardous environments, micro-robotics, and sensors. Recently MITI has proposed a \$1 billion dollar international manufacturing software initiative called Intelligent Manufacturing Systems. While the rest of the world debates the merit of this effort, MITI is proceeding with internal programs in Japan.

The AEA fully supports funding increases for the Technology Administration and the National Institute of Standards and Technology's intramural programs. A severe lack of funds and personnel has hampered their ability to fulfill critical roles helping industry strengthen the U.S. technological and manufacturing base, improve the transfer and commercialization of federal R&D, advance international technology and manufacturing cooperation, promote quality, and develop measurements and standards. In addition, funding traditionally provided to MST by DOD appears to be drawing down. The cooperative R&D made possible by DOD's funding, in areas from standards to electronic commerce, has been a key component of MST's core capabilities. As part of accepting the well-deserved budget enhancements, NIST

should be encouraged to include industry earlier in the strategic planning and program assessments process.

Let me qualify my remarks here, and then return to one of my primary initial themes. While MST has already developed significant in-house capability in some areas of robotics and manufacturing, and has held seminars and open houses for business, for example, it has lacked industry input into its research planning and most small and medium-size companies have not benefited from MST's research. In robotics, at least, NIST has not been very proactive in obtaining industry input to determine what technologies and projects would be useful to U.S. robot companies and end users. In twenty years of working in robotics, I have never been invited to a technology planning session at MST. Secondly, a company with 10 or 20 engineers often cannot afford to send 2 or 3 engineers to NIST for an extended period of time, typically 6 months, to really understand and absorb MST developments.

If NIST technology programs are to be beneficial to industry, they should incorporate industry input in a planning process and have specific mechanisms to ensure that NIST technology is accessible to, and fully employed by, a range of U.S. industry.

TITLE VI INFORMATION INFRASTRUCTURE

The AEA is eager to work with Congress on the Information Infrastructure and Technology Act of 1992, which would advance research in the application arenas of education, manufacturing, health care, and libraries, and contribute to the development of the "Information Superhighways" for the 21st century. We believe this represents an important step in the evolution of the High Performance Computing and Communications Initiative toward solving the computational and communications problems of a broad range of Americans. The greater the focus on "real" problem solving, the greater the national benefits that will accrue from our leadership in high-performance computing and communications. AEA is preparing detailed comments and recommendations on Title VI for submission to the Committee.

I would now like to turn to the issue of technology financing.

TECHNOLOGY DEPLOYMENT: FINANCING VENDORS AND BUYERS—THE PROBLEM: VENDORS

The early and mid 1980s was the "Age of Start-Up," a period when investment in high technology flourished and a period which produced such giants as Sun Microsystems, Microsoft, and Compaq Computer. America has benefited from these companies. It has benefited by their exports, the thousands of jobs they have created, and the cutting edge technology they have produced. Internationally, the U.S. is more competitive because of them.

But for more than five years our nation has failed to produce a new generation of such companies. The reasons for this precipitous decline are many, but chief among them has been the alarming and growing inability of American entrepreneurs to obtain seed and venture funding.

Institutional venture capital disbursements in new developing companies have fallen from \$4 billion in 1987 to \$1.9 billion in 1990 to \$1.4 billion in 1991. Equally important, informal investors, who commit some \$50 billion per year to small growth companies, have also dramatically reduced their venture investments.¹

These long-term equity investments—whether from individual investors or professional venture capital funds—are the lifeblood of America's entrepreneurs. Traditional debt financing by banks is generally not available to entrepreneurs for capital investment because their enterprises are considered too high-risk or lacking in sufficient collateral. Tightened banking requirements are forcing those small businesses which do have collateral into the secondary financing market where the interest rates are on the order of 12 percent as opposed to 8 percent in the primary lending market. In addition, loan periods and repayment schedules are too short term and collateral requirements are unreasonably conservative.

What this means is that American start-ups are too often unable to take ideas out of the garage and into the marketplace. Moreover, what venture funding is available, is too often focused only on product development; when it becomes time to put a product into production the venture-capitalist-controlled Board of Directors tells management "Go find a strategic manufacturing partner." This generally translates to finding an Asian manufacturer. Young companies have been forced to seek funding from foreign investors or go out of business altogether. Attached as Adden-

¹Based on data from Venture Economics of Newark, New Jersey, a company which provides financial information and advisory services.

dum 2 is an anecdote about a small electronics company which illustrates these problems.

THE PROBLEM: BUYERS

Small businesses in the U.S. are also at a severe disadvantage with respect to Japan when it comes to funding the acquisition of manufacturing technology. Specifically, if we return to our example in robotics, Japan provides:²

1. "Mechatronics investment promotion tax system" (7 percent of investment, limited to 15 percent of tax liability)
2. Accelerated depreciation (1 to 5 years)
 - a. For robots, first year 30 percent
 - b. For semiconductor equipment up to 100 percent in first year
3. Low cost of capital
 - a. 5.3 percent, 10 year loans available for robots in 1992
 - b. Cost of equity capital 3 percent-5 percent in 1990
 - c. Long-term capital gains tax is 5 percent
4. Small business support for robots; established 1980 still in effect
 - a. Interest free loans up to \$240,000
 - b. Lease rate of 4.5 percent up to \$160,000
5. General small business support in Japan
 - a. Fiscal Investment and Loan Program (\$29 billion, 1989)
 - b. Credit guarantee association loans (\$56 billion, 1987)
 - c. Public testing and research centers (185 in 1985, 7,000 employees, \$470 million/yr)
 - d. Local technology demonstration centers

U.S. federally guaranteed loans to small business were about \$3.6 billion in 1989. Japan, with a smaller economy, provides about twenty times the U.S. financing aid to small business.

SOLUTIONS: VENDORS

Concerted, bi-partisan effort is needed to provide U.S. industry with a globally competitive financial environment. Congress and the Administration must take a comprehensive approach to ensure investments in critical technology companies. Critical elements include: providing a targeted capital gains differential, a permanent R&D tax credit, a non-incremental investment tax credit; and re-focusing federal funds to R&D programs that help make U.S. industry more competitive, including programs of the National Institute of Standards and Technology, the Advanced Research Projects Agency, and the National Science Foundation.

Industry and government also need to explore new, progressive methods of providing low-cost, patient capital to America's critical industries. Our industry's capital needs run the gamut from initial capitalization for small start-ups, to mezzanine financing for growing companies, to working capital for established businesses.

The AEA endorses a proactive role for the Government in providing needed financing for technology-intensive U.S. companies and supports the establishment of a pilot program of new financing mechanisms authorized under Title III. As the Committee considers Title III, we recommend that Members consider modifications to ensure that the new financing mechanisms effectively provide long-term capital and enable small businesses to gain access to these resources.

RECOMMENDATIONS

Let me outline some improvements we think could be made. The National Competitiveness Act authorizes the licensing of "critical technology investment companies" to administer both loans and venture capital. The pilot capital amounts are modest; justifying expanding these programs will require success of the pilots. Several factors are critical for success. First, these programs must be administered by experienced personnel with proven track records. Such organizations exist, including special banks such as Silicon Valley Bank, established venture capital firms, and pension funds that specialize in technology and industrial financing. The selection and evaluation of these firms might be facilitated by a panel or board consisting of bankers with experience in manufacturing and technology loans, and well-known venture capitalists.

A critical element for the effectiveness of any financing program is a rapid decision-making process. Programs must be structured to delegate authority and deci-

²Office of Technology Assessment Report, "Making Things Better: Competing in Manufacturing," pp. 161-163.

sion-making to the licensed administrators of funds. Existing programs, such as those of the Small Business Administration, for example, are notorious among entrepreneurs for their lack of efficiency, overwhelming paperwork, vague eligibility criteria, and ongoing reporting requirements. Therefore, provisions in Section 323 that require Commerce to "follow the statutory requirements and use the statutory authorities which apply to the SBA's Small Business Investment Programs," raise concern with the AEA and should be carefully considered by the Committee.

The most critical aspects of funding new technologies is to deliver the needed financing to the recipients in the most timely and effective manner. The total decision making time should be a small fraction of the time it takes to deliver the technology to the marketplace. For 6 to 7 year technology delivery times, this means 6 or 7 months. It is imperative that the decision processes for the financing programs authorized in Title III are structured to address this. The following issues should be addressed through amendments to S. 4 and/or through vigorous oversight by the Committee of the programs implementation.

Some of the mechanisms that have been used effectively by private industry and can be used to improve the decision processes of Title III programs are:

- Map the decision flow process and identify the value added steps. Value added steps are those that are directly relevant to the customer. Non value added steps include the time to make decisions, replicating approvals, filing / storing, transport/ communications, etc.
- Identify measurement goals and indicators to monitor and control the decision process. Data from these indicators should be included in the Annual Report to Congress.
- Set up an information system (database and network) to disseminate information which will enhance the quality and reduce the time needed to make decisions.
- Eliminate barriers by pushing the decision approval to the lowest possible level. Also, the decision making should be monitored for effectiveness and value-added.
- Ensure that experts on both technical and financial matters are available to the Commerce Department to expedite proposal review. As with the ATP review process, proposal review for these programs should be both internal as well as external to the government.
- Identify specific advocates inside the government to assist the licensees and potential licensees by providing information and cutting through red tape.
- Reward those who contribute to timely and effective decision making by establishing accountability for the teams involved and recognizing superior performance against the goals set above.

In summary, the decision processes for the new financing mechanisms (particularly with respect to selecting licensees and making loans) should focus on value creation and timeliness by removing barriers and rewarding fast cycle time results.

SEED FINANCING

Seed financing for new companies comes primarily from individual investors who may provide up to a few hundred thousand dollars to get an idea off the ground. As mentioned earlier it is estimated that these "business angels" provide 20 to 50 times the amount of financing that the venture capital community provides. This financing has declined along with venture financing. The most effective stimulus to encourage this financing is a reduction in long-term capital gains taxes. In order to encourage patient equity capital, the AEA recommends a significant reduction in capital gains after a five-year holding period followed by a gradual reduction to zero after ten years for investments up to a capitalization of \$100 million. Small business is providing almost all the job growth in the United States. The growth rates of a large percentage of AEA members are limited by their ability to obtain financing.

START-UP FINANCING

The distinction between seed financing and start-up financing is that start-up financing usually involves sums between a few hundred thousand dollars and a few million dollars. It is used once a company has a business plan and some proof of concept. It is beyond the scope of most individual investors and has been almost exclusively provided by the venture-capital community. While many small low technology businesses such as bicycle repair shops and pizza parlors can be established with the small amounts of capitalization available from individual investors, almost all high-technology companies require multiple millions of dollars for product, market and manufacturing development. Not only has venture capital financing fallen in total; venture financing of manufacturing technology companies has almost disappeared. Venture Economics reports that in 1991, of \$1.4 billion invested in new companies, \$54 million (3.9 percent) was invested in industrial products, \$134 mil-

lion (9.8 percent) was invested in electronics, and \$700 million (50 percent) was invested in communications, computer hardware and software. Manufacturing technology funding is likely to be a small fraction of the industrial products funding. As a result, the proposed S. 4 funding of \$105 million which might seem small compared to the 1.4 billion invested by venture firms in 1991, would in fact provide several times the 1991 funding of industrial products companies if it were all invested in this area.

Several investors expressed interest in providing lower-cost equity to small companies, especially if it could help leverage other money. One comment was "If I could provide a company with \$3 million at \$2/share of private money (high cost to company) and \$3 million at \$4/share of public money, everyone wins. The company wins as its average cost of capital is decreased. The private investment partners win because their investment is aided by lower cost funds. The government wins because its investment is leveraged by higher cost private funds. My investment company wins because we can put more money in the company." This investor felt that a 15 percent management fee on capital gains would be attractive enough given this scenario that his firm would manage these funds at an average 20 percent target return instead of their usual 50 percent. He was further excited by the prospect of making loans available to qualified companies. He stated that absolutely no term loans are available to start-up and small capitalization companies at any rates.

RECOMMENDATIONS

The mechanism by which this financing is administered will be critical to the success of the program. AEA endorses the idea proposed in S. 4 of licensing critical technology investment companies to administer these funds. There are several reasons. First, if the program is to succeed, investment decisions should be made by experienced professional investors. A balance must be struck between the desire to support critical technologies and prudent administration of public funds. There are a limited number of professional investors with small business experience. These investors are primarily in the venture capital community and it would be difficult to attract the most competent to work for the government. Secondly, the time period for decision making must be on the order of two or three months. This is not likely with a government-administered program.

It is very important that the entire investment decision be made by the investment company. There should be broad guidelines for what technologies are deemed critical technologies. These guidelines should be updated annually with strong industry input, and provided to the investment companies. However, the government should not review actual investment decisions, nor should it require extensive paperwork to be filed. One venture firm with whom I discussed this proposal stated that his firm started as a Small Business Investment Corporation for its first fund. He said the paperwork required by the SBA both on his part and on the portfolio company's part was so onerous that his firm quickly changed to a limited partnership and refused to be involved with government funds. The government should provide oversight in the same way limited partners provide oversight to the investment companies: through annual meetings and the periodic decision to create or not create a new fund. Several state investment funds now participate in venture capital limited partnerships in this manner, including the State of Michigan.

If venture capital or similar types of firms are licensed as critical technology investment companies, in order to attract competent firms, there must be a financial incentive similar to the incentive they get for managing private money, with the proviso that they be able to lower their average expected compounded return from 50 percent to the 15 percent to 20 percent typical of most small growth companies. Today, venture capitalists take a 15 percent to 25 percent management fee on any capital gains and must promise better than a 20 percent average annual return to their institutional investors. This raises their compounded return requirements for investments. The AEA recommends that the government pay a management fee of 15 percent and consider a lower return goal, perhaps 3-6 percent, so that these funds can be invested in companies with projected growth rates closer to industry averages. This will greatly expand the number of companies eligible for funding while attracting professional management.

MEZZANINE FINANCING AND WORKING CAPITAL

Due to a major tightening of banking regulations, it is currently almost impossible for small high-technology businesses to get term loans. Even loans that are available must be collateralized by receivables and are only available at high rates: 10 percent to as high as 24 percent for receivables factoring. Paradoxically, the default rate for well-managed industrial lending has been extremely low: for example less

than 1 percent at Silicon Valley Bank. In addition, discussions with bankers indicate that there is a substantial institutional market for industrial loans. There are two reasons these loans are not being brokered. Under current banking law banks cannot make them. Secondly, there is a very limited number of experienced commercial bankers who understand technology lending. If an entrepreneur has a market lead with a hot new product and needs financing to manufacture it, most commercial bankers say "Come back when you're profitable". The proposed critical technology investment companies have the potential to address both these problems. If they are structured as investment corporations, they do not fall under banking law restrictions. If they can be made attractive to venture and other professional investors, they can draw on experienced investment personnel from outside the banking community. In the AEA's view, the pilot program proposed under Title III, if properly administered, has the potential to serve as a prototype for industrial loan corporations and has an excellent chance of being a profitable business enterprise. The AEA considers it likely that if the government approves this format and does not encumber it with paperwork, that private industry will rapidly follow suit and expand the number of industrial loan corporations.

RECOMMENDATIONS

The "Critical Technologies List" used to drive both financing programs should be regarded as an active and dynamically changing list. S. 4 should include a formal mechanism to provide for broad-based industry input to the designation of "critical technologies." The Committee should consider directing the Critical Technologies Institute, under the auspices of the President's Science Advisor, to provide the leadership for reviewing and revising the Critical Technologies list on an annual basis instead of the currently required bi-annual basis. The List should include technologies that, while not having broad-base applications, have substantial strategic impact. Further, the interpretation of the List for the purposes of S. 4 should be modified based on early experience.

FINANCING BUYERS

S. 4 does not propose any special incentives for the purchase of manufacturing equipment other than its general financing provisions. The AEA believes that a targeted investment tax credit which encourages investment in productivity would benefit the country. During the 1980's a great deal of potential investment capital was squandered in leveraged buyouts and corporate takeover battles. Tax policy which encourages investment rather than investment bankers is badly needed. The table below correlates the investment tax credit with productivity.

The Investment Tax Credit, Investment in Producer's Durable Equipment and the Employment/Population Ratio

Year/Quarter	Producer's durable equipment outlays; percent change	Producer's durable equipment average annual growth rate	Employment/population ratio average annual growth rate	Date of change in ITC
1957:1-1961:4	2.70	0.60	-0.70	ITC not yet instituted.
1962:1-1966:3	63.90	11.60	0.60	ITC of 7 percent effective Jan. 1962.
1966:4-1967:1	-3.80	-14.40	-0.80	ITC suspended Oct. 1966.
1967:2-1969:1	11.40	6.40	0.70	ITC of 7 percent reinstated Mar. 1967.
1969:2-1971:1	-5.60	-3.20	-1.20	ITC eliminated Apr. 1969.
1971:2-1974:4	27.50	7.20	0.50	ITC of 7 percent reinstated Apr. 1971.
1975:1-1985:4	64.00	4.70	0.90	ITC increased to 10 percent Jan. 1975.
1986:1-1992:2	13.60	2.10	0.30	ITC eliminated Jan. 1986.

Calculations by the American Council for Capital Formation Center for Policy Research

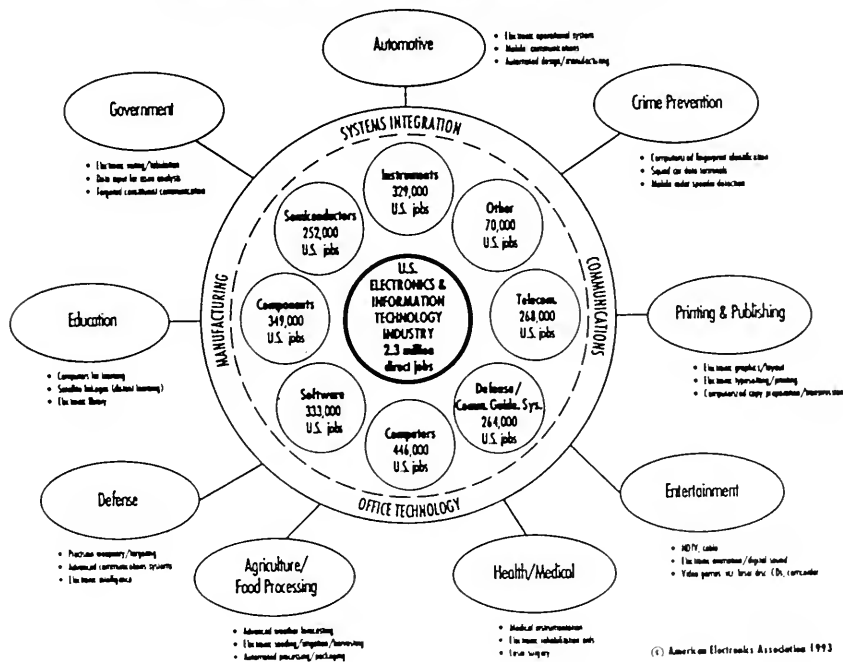
SUMMARY

Let me summarize my recommendations on behalf of the AEA. The Association believes the programs outlined by S. 4 will provide a significant contribution to the competitiveness of U.S. business. The AEA encourages private sector input to each of these programs and would like to work with the Congress and the Administration in crafting private sector input mechanisms. We believe that establishing a coordinated approach to national programs is vital. Critical to the effectiveness of all federal financing mechanisms are decision processes that focus on value creation and timeliness. The AEA looks forward to providing more detailed comments and recommendations as S. 4 is considered by Congress. The Association's members are

anxious to work with both Congress and the Administration to enhance the global competitiveness of industry and contribute to America's economic well being and quality of life. Thank you very much for the opportunity to present our views.

ADDENDUM #1

Electronics Drives Product/Process Improvement in Other Sectors



ADDENDUM #2

The following is a discussion about a small electronics company which illustrates industry's current financing problems. The statement has been edited to protect the privacy of the companies.

"Company A" is a small industrial automation supplier that was founded about three years ago by individuals from a large electronics company. Company A, which specializes in automation for integrated circuit testing and assembly, has revenues of about \$3 million and approximately 20 employees. Company A currently has a quote in to a different large electronics company for an \$800,000 automation project. However, Company A is thinly capitalized and the large electronics company wants Company A to come up with at least \$300K of additional working capital before it will place a purchase order. Company A is currently talking to a venture capital firm that is interested in investing several million dollars in the company, but wants control of the business in exchange. So Company A has a potential \$800,000 order and may have to give up control of the business to accept it.

This case illustrates several problems. First, many industrial automation projects are contracted to outside system integrators like this company. This is because most U.S. companies cannot afford to maintain automation system integration resources in-house. Many of these integrators serve niche markets and, as a result, tend to be small engineering companies with limited financial resources. In addition, many end users prefer dealing with smaller engineering companies because they have lower overhead costs, can often respond faster, and may have unique technical expertise when compared to large engineering companies. These small companies provide a vital resource for U.S. manufacturers. It is a fragile resource.

Many of these companies are thinly capitalized. The system integration business has never been highly profitable, and users tend to shop for the best price and will often abandon a proven vendor if someone else offers a lower quote. As a result, it is difficult for these companies to attract venture capital (which typically looks for a business plan offering 40% or better return on investment). Many banks are not loaning money to small business at all; and when they do, the cost is over 12 percent. The system integration business also has a unique demand: system integrators typically must purchase equipment from vendors, pay for it in 30 to 60 days, and keep it on their floor until the end user accepts it. A \$1 million order may require the purchase of \$500,000 worth of equipment.

The CHAIRMAN. Thank you very much, Mr. Carlisle.
Mr. Brooks.

STATEMENT OF GEORGE BROOKS, ON BEHALF OF THE NATIONAL COALITION FOR ADVANCED MANUFACTURING

Mr. BROOKS. I am appearing on behalf of Don Davis, who had to return to do regular work. I collaborated with him in the preparation of the testimony and if you will assume that I am reading his words and take that transition in mind, it will go smoothly.

Senator Hollings, distinguished members of the committee, if he were here, it would be Don Davis, Jr. of Milwaukee, WI.

We express our appreciation to you and the National Coalition for Advanced Manufacturing for the opportunity to talk with you today.

We have a brief statement, after which I would be pleased to address your questions.

My perspective is that of a U.S. citizen who cares about U.S. prosperity. And as an industrial businessman and graduate engineer who has been associated with American manufacturing for more than 30 years—in my case it is 40.

I have been privileged to serve as president of Allen-Bradley Co., a worldwide operating subsidiary of Rockwell International. Of the major players in our industry, we are the only American-owned company and are considered a world leader in our field.

Our customers tend to be other manufacturers, ranging from international corporations deeply involved in computer-integrated manufacturing to small machine shops. My company is an implementer of advanced manufacturing technology as well as a supplier.

In the light of all that, I believe therefore I can speak to the technology state and needs of medium- and small-sized companies along with that of large corporations.

Much has been said and written about what usually is termed the "emerging, global marketplace." From my viewpoint, the global marketplace has now ceased emerging and is full grown and feisty.

We are told that in this intense international arena, only the strong, swift, and sure will survive the competition. Most experts agree that survival requires superior product design, shorter time from concept to product, and competitive pricing derived in part from productive manufacturing techniques and technology, all resulting in superior customer satisfaction.

In this discussion, we often hear how European and Asian competitors have advanced factories, sophisticated equipment, advanced management practices, large R&D investments, and governments which actively create favorable climates for growth and development of manufacturing.

In the area of advanced manufacturing technology, many of our major corporations can stand toe to toe with any company anywhere in the world. But behind all major corporations are layers of small suppliers. And it is especially there that a difference exists.

For in comparison with their international counterparts, a smaller second- and third-tier company is not as well equipped with capital or modern manufacturing technology. American's future depends, demands, that we change this manufacturing technology shortfall.

The National Competitive Act in 1993 will, I believe, help effect that change. It should improve technology penetration into the second and third tier and improve the quantity, quality, and productivity of this Nation's skilled workforce.

This act evidences Government's growing awareness of manufacturing's importance to America. And I commend you for that and I also commend those who researched and wrote this bill.

Experience with business along with Don's service on a competitiveness policy council tell me that this act is the right policy at the right time. In combination with a tax policy that encourages investment versus consumption and education systems strengthened in math and science and a real reduction in the Federal deficit, this act can have a major positive effect.

However, I must also share some specific concerns with you. They are, one, our urgent need for a recognized national priority for manufacturing. I emphasize "recognized." Efficiency in implementation, execution, and oversight, and three, the importance of people to the technological process.

A moment ago I commended you and others for your increasing awareness of manufacturing's importance. However, increasing awareness is not enough. We must speak to the issue, too, whenever and wherever an opportunity presents itself.

Were I to sit here and tell you that manufacturing is essential to our country, now and for the future, you might wonder why I took this time to state the obvious. Yet many of us treat this point as a given, so fundamental that it is seldom discussed.

Every day, in this society, hundreds of thousands of manufacturing plants in all 50 States, millions of productive Americans create the wealth that fuels this Nation. Together with farmers and miners, they are the basic source of all the new wealth that builds the roads, buys the houses, purchases the groceries, and pays our salaries.

Yet their daily role as a consistent, reliable backbone and muscle of America is under-recognized and underappreciated. Their contribution seems to be addressed publicly only if they lose their jobs.

We in the leadership positions throughout this Nation must strive to change that. By doing so perhaps we will make careers in manufacturing attractive to our young people.

A brief aside—MIT University has a new, very expensive but I think efficient, program to introduce manufacturing as an attractive career to people. A number of companies sponsored and participated in it.

We sent out team there to evaluate the program. They have studied and have put out their first class. The young people in this

class listened to our people and talked to them and they said, "How could you let this happen to us?" The young people in this country who have become informed about the state of our manufacturing environment are terribly disappointed in their seniors who let it happen. That's us.

My second concern is about efficiency and execution. Funding the bill, though modest for our national program, seems to be adequate at this time for the task outlined. Yet history tells us success requires more than passing a law and appropriating funds. I would encourage you to ensure with legislation where appropriate, with counsel where needed, that the administrators through whose hands these funds flow, practice the same superior management principles which we urge upon American manufacturers.

You, your staff, and the agencies charged with administering this act should ask, What are the benchmarks of successful implementation? How do we measure good work? What are the quality standards we will use to measure this program in action? Have we done everything possible to ensure continuity and stability in out-year funding?

How do we prevent the process from siphoning off so much resources that the outflow at the recipient's end is a mere trickle rather than the gusher that we intend.

What safeguards guarantee the assistance generated by the act goes where it is really needed, rather than to projects, programs, and locales which may be politically appealing but economically questionable?

Just as efficient business managers require a continuing assessment of the return on investment, you too should demand continuing analysis of the return this Nation will be receiving on our collective investment to fund this act.

For those people charged with administering the act once it is law, we urge a program of total quality management, TQM, much in the words these days, in the process and the standards by which the act will be administered and the impact assessed.

That includes testing and validating the methods, developing metrics to monitor effectiveness and exercising the will and flexibility to fine tune the program in out-years. In short, it means practicing the principle of continuous improvement in Government administration, just as we strive for continuous improvement in business and technology.

The third concern I wish to discuss is really a plan. That we not permit people to become lost in the discussion of technology. We in manufacturing increasingly know that technology transfer and growth occur at an intensively human level, basically through the effective interaction of teacher and pupil.

Therefore let us use as technology teachers, those talented individuals who no longer are effectively employed due to industrial downsizing in general or defense conversion in particular. These technologically knowledgeable people are a talent pool which can materially enhance this program's effectiveness.

In pursuit of that perhaps we could create a system by which a competent engineer, scientist, technologist, or technician could be employed within a small business with his first year on the job or her first year paid for by the Government, the second year could

be funded by the Government and small business, and the third year and beyond paid for by the benefiting company.

Such a program would constitute a plan of phased introduction of technology resources into small businesses. The program could be implemented through this act's training and technology centers and perhaps funded with defense conversion dollars.

In closing, I have one final point. As real as my concerns are and as strongly as I urge you to either address them or ensure that others do, these concerns in no way diminish our strong support for this exceptional piece of legislation. The National Competitiveness Act of 1993 deserves the support of this committee, this Congress, this administration, and the support of every American whose future depends directly or indirectly on the quality and future of American manufacturing. And that truly is every American.

Thank you.

[The prepared statement of Mr. Davis follows:]

PREPARED STATEMENT OF DON H. DAVIS, JR.

I am Don H. Davis Jr. of Milwaukee, Wisconsin. I have prepared a brief statement, after which I would be pleased to address any questions and areas you wish.

I have come here at your kind invitation and that of The National Coalition for Advanced Manufacturing to testify in support of Senate Bill 4, The National Competitiveness Act of 1993, and also to discuss with you several concerns regarding implementation of this legislation as well as America's manufacturing future.

My perspective is that of an industrial businessman and graduate engineer who has been associated with American manufacturing for more than 30 years. For all of that time, the company with which I've worked has manufactured products which primarily were sold to and used by other manufacturers. That remains true today.

I am privileged to serve as president of Allen-Bradley Company, a worldwide operating subsidiary of Rockwell International. Of the major players in our industry, Allen-Bradley is the only American-owned company, and we are considered a world leader in the field. Almost without exception, our customers are other manufacturers here and abroad, ranging in size from multi-billion-dollar corporations at the leading edge of computer-integrated manufacturing to small machine shops. My own company also is a implementer of advanced manufacturing technology, as well as a supplier. In light of all that, I believe I, therefore, can speak to the technology state and needs of medium and small-sized companies, along with that of large corporations.

GLOBAL COMPETITION

Much has been written and said about what usually is termed the "emerging, global marketplace." From my viewpoint, the global marketplace now has ceased "emerging" and is today full-grown and feisty. We also frequently are told that in this intense, international arena only the strong, swift and sure will survive the competition. And that is true. Most experts agree survival requires superior product design, a shorter time from concept to product, and competitive pricing derived in part from state-of-the-art, highly productive manufacturing techniques and technology * * * all resulting in superior customer satisfaction. That, too, is true.

In this discussion and debate about the global market, we regularly are told (and often in exquisite detail) how European and Asian competitors have advanced factories, sophisticated equipment, R&D investments exceeding the U.S. norm by considerable margins, and governments which actively create climates conducive to the growth and development of advanced manufacturing.

SECOND- AND THIRD-TIER DISPARITY

In the realm of advanced manufacturing technology, many of our major corporations can stand toe-to-toe with any company anywhere in the world. But behind all major corporations are layers of smaller suppliers. And it is especially there that a difference exists; a difference we must remedy. For in comparison with their international counterparts, our smaller second and third tier companies are not as well equipped with capital or with modern manufacturing technology.

Of the approximately 360,000 smaller American manufacturers (those who employ 500 or fewer workers) most have not advanced in adoption of modern manufacturing technology and methods from where they were a generation ago. Only 6 in 10 of them now employ advanced technology, compared with 9 of every 10 plants with more than 500 employees. Yet those smaller companies constitute 98.5 percent of all our manufacturers, 63 percent of America's manufacturing workforce, and they account for half the manufacturing done in this country.

Clearly, if we are to reshape America's manufacturing outlook, we must recognize that it is these smaller companies which most need the efficiency and flexibility inherent in modern advanced manufacturing. And then, having recognized that challenge, we must help meet it. Indeed, this situation must be changed, and that change must be encouraged and supported by positive tax and investment policies, as well as by a well-educated and well-trained American work force.

In saying that, I am not primarily speaking of engineers and scientists and executives. Rather, I am more concerned about the shop work force—people more critical than ever today to cost-efficient and effective manufacturing. Those workers and the source of their training often are omitted from discussion of this issue, so am especially pleased to see education woven throughout this Act. To speed arrival of the future we all want, we must go beyond investing in and building worker training and re-training programs. We must instill a new emphasis on math and science below the college level. We must cause young Americans to realize that college is not the only success option. The various centers created or enhanced by this Act, coupled with the partnership of industry, labor, education and government it envisions, should help address that need, too.

A LAUDABLE LAW

In sum, I truly believe The National Competitiveness Act of 1993 will go a long way toward improving technology penetration into the second and third tier, and toward improving the quantity, quality, and productivity of this country's skilled work force. This Act evidences growing awareness in Congress and the Administration of manufacturing's importance to this country. And I commend you for that. I also commend the people who researched and wrote this bill; it is a superb piece of work. And I commend our President for his statements last September on the importance of manufacturing.

When this Act is passed, fully funded, and implemented, believe it will have a substantive, positive effect upon American manufacturing. I also believe it will help create jobs—the most valuable kind of jobs—manufacturing jobs. As the multiplier effect tells us, every new manufacturing job results in at least 10 new service jobs; the average manufacturing job also pays 44 percent more than the average service job, and more than twice as much as the average retail-trade job.

So yes, I strongly support this legislation. My years in manufacturing and my service with the Competitiveness Policy Council (in the company, I might add, of such distinguished people as Senator Bingaman, Senator Lott, and Chairman Tyson) tell me this Act is the right policy at the right time. And I find special worth in Title II of the Act, which cites a clear potential for "dramatic improvement across all industrial sectors in productivity, quality, and the speed with which manufacturers can respond to changing market opportunities." In combination with a tax policy that encourages investment versus consumption, an education system strengthened in math and science, and a real reduction in the federal deficit, this Act can have a major, positive effect. And I support it.

CONCERNS

However, I would be remiss in telling you that, if I did not also share several specific concerns with you. They are:

- 1) Our urgent need for a recognized national priority for manufacturing, established and reinforced over the long-term;
- 2) Efficiency in implementation, execution, and oversight; and,
- 3) Awareness and promotion of people as a vital element in technological progress.

Permit me to briefly cover each of those points.

First, a recognized national priority for manufacturing.

A moment ago I commended you and others for your increasing awareness of manufacturing's importance. However, increasing awareness is not enough. We must speak to the issue, too, whenever and wherever an opportunity presents itself. Were I to sit here today and tell you that manufacturing is essential to our country now and for the future—that manufacturing is the largest by far of the only three ways we have to create real wealth (the others being mining and agriculture)—you

might well wonder why I had taken this time to state the obvious. Yes, many of us treat this point as a "given," so fundamental that it is seldom discussed.

But, every day in this society, at hundreds of thousands of manufacturing plants in all 50 States, millions of productive American men and women create the wealth which fuels this Nation. Together with farmers and miners, they are the basic source of all the new wealth which builds the roads, buys the houses, purchases the groceries, and pays your salary and mine. Yet their daily role as the consistent, reliable backbone and muscle of America is under-publicized, under-recognized and under-appreciated. Their contribution seems to be addressed publicly only if they lose their jobs.

We in leadership positions throughout this Nation must strive to change that. By doing so, perhaps we will help make careers in manufacturing attractive to our young people. To your credit, many members of this Committee have articulated this truth, especially over the past two years. Not only must we continue doing so, we must recruit our peers to join us. The system created by this Act will do a credible job of advancing technology in DEED; we must ensure it does an equally credible job in WORD as well.

EFFICIENT EXECUTION

My second concern is efficiency in execution.

Funding in the bill, though modest for a national program, seems to be adequate at this time for the tasks outlined. Yet we in this country have often in the past established highly sophisticated, very detailed plans for success; but the execution of those plans sometimes is wanting. I would encourage you to assist—with legislation where appropriate, with counsel when needed—in ensuring that the administrators through whose hands these funds will flow practice the same superior management principles which we urge upon American manufacturers.

The following questions should be asked by you, by your staff, and by the agencies charged with administering this Act:

- 1) What are the benchmarks of successful implementation?
- 2) What is the quality standard or standards by which we will measure the effectiveness of this program?
- 3) Have we done everything possible, consistent with the limitations of the federal budgeting cycle, to ensure continuity and stability in out-year funding?
- 4) How do we ensure the intended recipient of the benefit actually receives it in full measure? Or in other words: How do we ensure the process does not siphon off so much that the outflow at the recipients' end is a mere trickle rather than the gusher we intend?
- 5) What safeguards do we install to make certain the assistance generated by this Act goes where it really is needed, rather than to projects, programs, and locales which may be politically appealing but economically questionable?

To illustrate the rationale behind that last question, let me note that I was born in Magnolia, Arkansas—just down the road from Waldo and about 35 miles from Hope, a town of which I believe you've heard. Despite that, I would be saddened to see a substantial portion of these resources flow to southwestern Arkansas merely because the population of Arkansans in Washington seems to have increased markedly over the past few months. I also would be saddened to see site selection for new manufacturing technology centers based upon who holds which committee chairmanship in the House or Senate, or upon which state's delegation is the largest or most senior.

My point in voicing this concern about execution is that passing and fully funding this Act is a beginning, rather than an end. It ensures only the input, not the output. For this program to function as believe you intend, passing a law and signing a check is not enough. Your continued attention is essential. In a well-run business, management exercises its fiduciary responsibility to shareholders by demanding a continuing assessment of the return on every investment; as you know, that decision criterion is called ROI. In government, your continuing fiduciary responsibility—to American taxpayers—should lead you to demand continuing ROI analysis of the return you and this Nation will be receiving on our collective investment to fund this Act.

For the agencies and people charged with administering the Act once it is law, I strongly urge a program of Total Quality Management in the design and implementation of the process by which this Act will be administered, and in the standards employed to assess its impact.

- Let us test and validate the methods by which we take the money to the end user.
- Let us develop metrics of monitoring the effectiveness of our program.

• And let us retain the will and flexibility to fine-tune this program in the out-years, practicing the principle of continuous improvement in government administration just as we strive for continuous improvement in business and technology.

THE HUMAN FACTOR

The third concern I wish to discuss with you this morning is in many ways the most important—a plea that we not permit people to become lost in the discussion of technology. We in manufacturing increasingly know that technology transfer and growth occurs at an intensively human level. It occurs through effective human interaction of teacher and pupil, of journeyman and apprentice, of task force and work team. Recognizing that, let us ensure that we use as teachers those talented individuals who no longer are effectively employed by virtue of industrial downsizing in general, or Defense industry conversion in particular. These often are technologically knowledgeable people—according to the Census Bureau, 83 percent of plants supplying Defense Department prime contractors employed advanced technology, versus 62 percent of plants which do not supply these contractors. So, individuals coming from such environments represent a world of talent—American talent—which can materially enhance this program's effectiveness.

In pursuit of that, perhaps this program could create and fund a method by which a competent engineer, scientist, technologist or technician could be employed within a small business—with his or her first year on the job paid for by the government program, the second year to be jointly funded by the government and his or her employer, and the salary for the third year and beyond paid solely by the benefiting company. Such a program would constitute a planned, phased introduction of technology resources into small businesses. This plan could be implemented through this Act's national training and technology centers, and perhaps funded through Defense conversion programs.

CONCLUSION

In closing, I have one final point. As real as my concerns are, and as strongly as I urge you to either address them or ensure that others do so, those concerns in no way diminish my strong support of this exceptional piece of legislation you have crafted. The National Competitiveness Act of 1993 deserves the support of this Committee, the support of this Congress, the support of this Administration, and the support of every American whose quality of life and future depend directly or indirectly on the quality and future of American manufacturing. And that truly is EVERY American.

Thank you.

The CHAIRMAN. Thank you very much, Mr. Brooks. I think the first thing, Senator Burns, I want to ask questions about the policy and then one followup relative to the financing.

But Mr. Brooks, just having gone through it over the past 20 years, you know, it was chic to realize that—like England—that instead of being a nation of brawn, we are going to be a nation of brains. Instead of creating products, we are going to handle their services and instead of creating wealth, we are going to handle that, too, and be financial centers.

And we are going to be a second-rate entity just like the United Kingdom, if we keep on with it. But, you know, small is beautiful, service economy and the actual affirmative action trade policy about a trade representative for the past several years, just forget about the manufacturing side.

Anything from copyrights, anything from financial services, anything but services was fine and that is what we have been swapping off in the GATT agreement and that is why we do not have a firmed up GATT agreement.

So, we agree with you. We like to hear you say the right policy at the right time. And I think everyone should understand that we came about this with a foot in the door kind of approach in 1988 in the trade bill. Then last year we got ready and worked on this bill with you folks and other folks from the various disciplines,

passed the bill in the House, passed it in the Senate, reconciled the differences, had a conference report and then it was politically held up.

So, we think we have got a pretty good bill, but even then we can always improve on it.

Mr. Prestowitz, what about the policy? If you were king for a day, how would you change this policy around?

Mr. PRESTOWITZ. Well, I think the key thing is really one of attitude and I think that is already beginning to change. That is, there has to be an understanding that what we make matters. The structure of our economy is an important determinant of our overall productivity and welfare. And therefore what we trade matters.

We often talk about our problem in trade as being the size of the trade deficit. And yet I think it is interesting to note that we have a large trade deficit with Saudi Arabia, but not a lot of trade problems with Saudi Arabia.

Or to look at it a different way, the largest export item from the port of New York City is waste paper. The largest export from the port of Seattle is unprocessed logs. And the fastest growing U.S. export is scrap aluminum.

Now theoretically, we could cut down enough trees in Oregon and Washington, gather up enough waste paper in New York City, gather up enough empty Pepsi and Coke cans and ship them all to Korea or Japan and balance our trade. I do not think that would solve our trade problem, because I believe the issue is not so much the size of the trade, but the composition, what it is that we trade.

And that means that in our trade policy, we need to have a results-oriented approach. It is very difficult to do anything useful in trade when we are talking about arguing over fairness or things like some other country's distribution system. It is much more productive to talk about whether or not, in the Uruguay Round, the results are going to increase the U.S. economic growth, increase the U.S. trade surplus or decrease it.

The same with regard to the NAFTA agreement and our many negotiations with Japan. So, I think the key to both domestic and international technology policy is a structural composition results-oriented approach. And to execute that, I think that in addition to the proposals that are made here and the programs that are being proposed and are already underway, I think there needs to be in the U.S. Government somewhere, a mechanism to do structural analysis.

By that, what I mean is the following: I can go to Tokyo and I can go down to MITI and ask them for a diagram of the structure of the U.S. economy and they will give it to me. I cannot go to the Commerce Department or the Trade Representative's office or the White House and get that same diagram from any U.S. agency.

We have many policies, as you know. Our trade policies, our regulatory policies, our antitrust policies, our defense R&D policies, which play a large role in determining the structure of our economy. And yet we have no mechanism that looks at all those policies through the prism of their impact on the structure of the economy. There is no set of criteria which leads a President or a policymaker to say, "Well, gee, before I spend this money or before I establish

that trade priority, what is that going to do to the overall structure of my economy or the composition of my trade?"

And I would urge that that kind of a mechanism be established.

The CHAIRMAN. Mr. Carlisle, do you have a comment?

Mr. CARLISLE. I think an understanding of what are going to be the critical elements of our economy as we go forward and how our policies will affect those elements, both our trade policies and our spending policies in terms of what technologies and education activities we undertake to pursue, is quite critical.

If we look at electronics manufacturing as an example, I mentioned in my testimony some \$36 billion of products that we cannot make in the United States at world cost anymore, things like VCR's, camcorders, and so forth. If we were to throw in some automotive manufacturing, we can easily get up to \$100 billion, roughly the number of our merchandise trade deficit.

We are going to need certain manufacturing technologies in order to be able to compete in these areas in the future. In electronics there is a steady trend toward miniaturization. We do not have the manufacturing technology in the United States to make the sorts of miniature products in consumer electronics that we see coming out of Japan. So, as new companies, or even existing companies such as Apple Computer look at how they are going to make a palm-top, hand-held computer, they set up joint ventures with Sony or Sharp in order to get the manufacturing capability to develop that product.

So, what has happened is because that manufacturing capability does not exist anymore, we now have to buy that capability or technology from, say, Japan. So, I would agree with Mr. Prestowitz that understanding what capabilities are going to be important for the future economic development of the country is very important toward figuring out what we ought to be spending our money and our education and our funding on, and will have an impact on trade.

The CHAIRMAN. Very good. Mr. Brooks, did you have any comments you wish to add?

Mr. BROOKS. My view of America's economy relative to these issues is intensely simplistic. In Sea Island, GA, there is a little marker, a historical marker on the wall sent over by the London Co. when they supported the first colony. It instructed the inhabitants to fence the land, plant the mulberry trees, prepare for the defense, build up the skills. There shall be no slavery in Georgia land. And the last admonition is perhaps the most important; take no lawyers to Georgia land. [Laughter.]

The CHAIRMAN. You must have knocked the ball in the rough down there at The Cloisters. [Laughter.]

I have been down there many times and have never seen that saying. [Laughter.]

I appreciate it very very much and I really appreciate the colleagues coming back. I have got an afternoon full of questions, but we want to get to the rest. Senator Burns.

OPENING STATEMENT OF SENATOR BURNS

Senator BURNS. Thank you, Mr. Chairman.

Well put, Mr. Brooks. Yesterday I had the privilege of taking a look at some new technologies being used in the ways of education.

And Senator Kerrey was down there yesterday and I am glad to see him here today because he has a great interest in this end of Government policy, the policies that we set that allow some of this to flow.

And I would yield to my friend from Nebraska, because I think he has got some things to say along that line, and yesterday was a very enlightening day and I wish more people would go down there and take a look and see what is happening around us that maybe a lot of us are not aware of. So, I would yield to our friend from Nebraska and welcome him here.

The CHAIRMAN. Well, I intended to welcome him also and have him at the witness table so we could get a full statement for the record. So, you go right ahead, and Bob, you do not mind holding up.

Senator KERREY. Not at all.

Senator BURNS. I have very few questions for this panel. I do have a couple of questions.

And, Mr. Prestowitz, I would have to agree with you in some areas where we have not changed our policy to reflect what is out there and what is happening in the private sector. We have been trying to do that ever since I have been here, as you well know, so there is enough blame to go around on why it has not happened. I think we have fertile ground why, and have every good reason to believe that we can effect some policy change to allow some things to happen at this time.

But I am the only Republican that is on S. 4 because I think this should happen. Now, I do not like everything about S. 4, but we have got to find the place to effect and to make some things happen.

Mr. PRESTOWITZ. I could not agree more, and I am glad you are—at least there is one Republican on S. 4.

The CHAIRMAN. And several others have indicated they are going to follow Senator Burns' leadership. Senator Exon.

OPENING STATEMENT OF SENATOR EXON

Senator EXON. Mr. Chairman, thank you very much. Gentleman, welcome. I have a few questions for you. First, Mr. Chairman, I think it is very important that you are going into this area. I salute you again for your leadership. I think linking the colleges and the universities are tremendously important, with the private sector, and Government has a role to play there.

Mr. Chairman, I recently wrote Vice President Gore on a program in which we have both been interested for some time, known as the Small Business Technological Transfer Program. This initiative, which was approved last year, would link small businesses with colleges and universities to work jointly on research, product, and development. I would like to ask that a copy of my letter to the Vice President in this regard be entered into the record at this point.

The CHAIRMAN. It will be included.

[The information referred to follows:]

LETTER FROM SENATOR EXON

MARCH 17, 1993.

The VICE PRESIDENT,
U.S. Senate,
Washington, DC 20510

DEAR MR. VICE PRESIDENT: As you may recall, I have been working for quite some time to link small businesses and colleges and universities to share research and technology. I worked with your subcommittee to win Senate Commerce Committee approval and Senate passage of the College and University Innovative Research (CUIR) pilot program in 1987 as a part of National Science Foundation Reauthorization legislation. Although that initiative was watered down in conference, it was an effort not in vain.

The idea was to build on the success of the Small Business Innovative Research (SBIR) Program which has helped many small firms take basic research into product development. Unfortunately, colleges and universities were explicitly prohibited from this program. The CUIR initiative would have encouraged colleges and universities to join in partnerships with small businesses to conduct basic research and bring new products to the market.

I am pleased to report that a version of the CUIR concept was adopted as part of the SBIR Reauthorization Act (P.L. 102-564). That program is known as the Small Business Technology Transfer (STTR) program. The 1992 legislation established pilot programs at the Departments of Defense, Health & Human Services, and Energy, as well as the National Aeronautics and Space Administration and the National Science Foundation. Under the program each agency funds cooperative Research and Development projects involving a small business and a researcher at a college, university, non-profit center or federal research center.

Agencies are to establish STTR programs within the next few months. Unfortunately, several agencies appear to be getting off to a very slow start.

The STTR program fits very well with the Clinton-Gore technology agenda. It is a bipartisan initiative which deserves the Administration's support. I seek your assistance in assuring the Congressional intent is fully implemented by the participating agencies. This program will be of great help to smaller population states such as Nebraska where technology investments are made in our colleges and universities. By facilitating cooperative efforts with small businesses, we can parlay that investment into lasting economic development.

The Administration's leadership in this exciting new initiative will bring two powerful forces together—small business and higher education to produce jobs, productivity, investment and economic development.

With best wishes.

Sincerely,

JIM EXON,
U.S. Senator.

Senator EXON. Mr. Chairman, certainly I want to say that rural States have a very long history of using technology and reaping the fruits of Federal technology programs. Through the Agricultural Research and Extension Service, S. 4 attempts to replicate that success in the manufacturing sector. Ironically, the success of those rural technological programs have permitted the American farmer to become so productive and have kept farm prices so low, that all farm economic opportunities are critical, absolutely critical, to the survival of many of our farm families.

I would simply like to ask if there are any recommendations from this panel with regard to manufacturing strategy for rural America? What can be done to address and assure that the rural community shares in the economic benefit of this type of a program?

Mr. BROOKS. May I take a cut at that?

Senator EXON. Certainly, Mr. Brooks.

Mr. BROOKS. The application of advanced manufacturing technology is just as applicable to the handling and processing and preparing of food for service and market as it is to cutting metal. And, in fact, many of the products of our company are used in that man-

ner. So, we have a strong interest in those aspects of this technology, applicable to the machinery and the processes of food handling, food preparation.

And in this area I would suspect that some of that activity might well be supported or otherwise pushed further down to the ground where the crop is developed, through the agricultural system. I am not sure how that ought to be done, but the machinery goes there.

Senator EXON. Thank you, Mr. Brooks. Mr. Carlisle.

Mr. CARLISLE. I have two comments. One, certainly advanced manufacturing technology is being used in the food industry. We have robots, for example, that are transplanting seedlings in greenhouses. We are doing food packaging in both the meat industry, the fish industry, the baked goods industry. So, some of this—obviously, a lot of technology has improved—machinery has improved the productivity of our farms.

I would also comment, however, that we are seeing now a dispersion of factories, in many cases out of our cities and into the country. And so we have a trend, which is being enabled by communications and by transportation, for many high-technology and other manufacturing concerns to get out of very densely populated areas and relocate into much more sparsely populated areas. And so we are starting to bring jobs back to the country, and I think that trend is important as well.

Senator EXON. Thank you very much.

Mr. Chairman, I would just like to ask this general question of the group. In recent months there have been several reports that the American worker is among the most productive or potentially productive workers in the world. What is your view as to where we stack up when compared to our international competitors in this particular area?

What is being done in foreign markets to keep the United States from reaping the full benefits of that productivity that we have been proud of for a long, long time? How should we respond and what can we do further? And do you think S. 4 goes as far as it should, can we go further?

Mr. PRESTOWITZ. Mr. Chairman, it is true that on an overall basis U.S. productivity, worker productivity, is higher than that of foreign countries. There are two important things to understand about that. One is that while that is true, it has been true for a long time and the U.S. lead is narrowing, narrowing very substantially. The growth in productivity in the United States over the past 20 years has been substantially less than that in other leading industrial countries.

Second, you know as the man said, figures do not lie by liars figure. Aggregates cover a multitude of anomalies. The U.S. farm sector, for example, is highly productive because we have very large farms and we are highly mechanized compared to, let us say, the Japanese farm sector which is not as productive as the U.S. farm sector, not because Japanese farmers are less efficient individually but just because the size of their farms is less.

The U.S. paper industry is very productive because we have a very large market. Our paper industry gets very long production runs and we have a favorable raw materials situation. Our alu-

minum industry is highly productive because, again, we have a favorable raw material situation, and relatively low cost of electricity.

Those strong productivity sectors for the United States balance out other sectors where we are not nearly as productive. In the automobile sector, for example, in consumer electronics, in machinery, machine tools, a whole range of manufacturing industries, U.S. productivity is less than that of our leading competitors.

And the importance of that is twofold. One, those tend to be the traded goods sectors. It is precisely in those sectors where our exchange rates and investment rates are determined, our R&D rates are determined, and we tend to be at a disadvantage there.

Second, a point that you implied is very important. Where we tend to be highly productive, in agriculture, in processed materials, in services, foreign markets tend to be closed to us. Where we tend to be less productive, in the manufacturing sectors, our market is very open and we are not able to penetrate foreign markets, and so we get kind of a double whammy.

And I think that the provisions of S. 4 are a step in the right direction, but as I said earlier, they need to be complemented by adequate trade policies. And I think that it is extremely important to understand that just because we have an overall lead in productivity, we cannot be blase or benign about the state of productivity in key industry sectors.

Senator EXON. My last question, Mr. Chairman, is a follow up, I think, on that, and I would like to ask if you could respond to this, Mr. Prestowitz. You are a student, I think, of long standing of the Exon-Florio law, which was one of the first laws that we had that really addressed high-technology matters internationally. And I have long respected your views and your advice on this subject. I think this fits in right now.

I would like to ask you to comment, if you will, on something that I think you know a great deal about. As you know, the Bush administration cleared the *Nakamachi/AMC* case on the day before the new President was inaugurated. AMC makes components for optical disk storage systems which are used in missiles and avionics systems. It therefore comes under Exon-Florio very clearly.

Do you have an opinion about the case that I have just referenced? Do you expect more high-technology defense-related firms to be going on the auction block, if you will, or being sought by foreign entities, even as the total level of the foreign direct investment declines?

Mr. PRESTOWITZ. Well, first of all let me say I thought that the action of the Bush administration in approving that transaction on the last day of their administration was unconscionable. I think that there will be a number of U.S. high-technology companies going on the block. The drawdown on the U.S. defense industry is inevitably going to result in a number of U.S. high-technology companies trying to reorient their business, being sold, and in many cases the interested buyers will be foreign companies.

I think that the Clinton administration will have a somewhat different view in its policy and in its execution of Exon-Florio than the Bush administration had. However, I do think that it is important for the Congress to make known its own opinion as to how that law should be executed.

Second, I have always been of the view that the wording of Exon-Florio is too narrow, and I would like to see the wording broadened to a broader definition of "national security." I like the term "economic security" rather than national security. I would urge you to amend the law in that direction.

Senator EXON. Well, thank you, and we are taking a look at that. That was one of the considerations early on in the original Exon-Florio measure. It did get into economics and we ran into all kinds of difficulty in that particular area with regard to restraint of trade, and that is a very broad figure indeed.

I happen to feel that the Exon-Florio wording probably is so broad that it gives the administration, in this case President Clinton, an awful lot of latitude. It kind of depends on whether it is going to be narrowly focused and determined, as under the Reagan and Bush administrations, or can it be expanded further. There is enough, I think, leeway in the wording of Exon-Florio that many people who want to come into the United States, certainly if there is any hint of national security interest, are forewarned.

I certainly would point out to you what I think you know. I have written to the new administration citing the case that I just referenced, and they have it under advisement as to whether or not they want to open that up once again, which I think they have the authority to do if they want. We will see what their actions are.

Thank you. Did you have a followup question, Senator Kerrey, on something I asked or referenced a moment ago?

The CHAIRMAN. We are going to invite Senator Kerrey to ask questions and we would be delighted to have him sit with the committee, but Senator Rockefeller.

Senator ROCKEFELLER. I will defer to Senator Kerrey.

Senator KERREY. Just as a follow on on what Senator Exon said, this morning's New York Times carried a story about the Commissioner of Education in New York City and New York State, Thomas Soball, making a proposal to the regents in New York State that work skills and school-to-work programs be a part of the curriculums for all students, not just those who are going into the workforce, but for all students.

We will graduate 2 million American students here in another 5 to 6 weeks. Dr. Soball's statement was, "we have reached the point in history where social and economic trends create crisis for many young people in the transition from education to work place. Research, our constituents, and the public tell us our students are not prepared for this new workforce or workplace as well as they should be."

Mark Tucker, what was quoted in the article as well, went on to say that "America is losing high paying jobs because its high school graduates are less skilled than European and Japanese peers."

Now I heard particularly, Mr. Carlisle, as you talked about the need to emphasize manufacturing. My own conclusion is as dire as Mr. Soball's, and I was curious as to whether or not you evaluated our high school graduates, the 2 million people that we will be producing—we will be giving them all degrees and certifying that they have completed 13 years of mandatory, 180-day-a-year training, average expenditure about \$6,000 per student. We will give them a diploma. And I would like to have your evaluation of how prepared

those young people are going to be for a workforce that is unquestionably internationally competitive.

Mr. CARLISLE. I think to a large extent the evidence speaks for itself. Many of our manufacturers are taking those students and re-educating them.

We have Motorola, which has put in place Motorola University. Xerox has done essentially the same thing. General Motors has done the same thing. Hewlett-Packard—most of our major manufacturers, large manufacturers, take our students and then sit them down and start to reeducate them.

They teach them math, they teach them communications skills, they teach them many of the basics of manufacturing. And so we are certainly, in the eyes of those organizations, not getting the benefit out of our education system that would make them productive workers upon entering the workforce.

I think that we have a real issue in that our small- and medium-sized businesses do not have those resources. So, while our large corporations are spending dollars on worker training, and in fact have the internal capability to do so, our 360,000 small- and medium-sized business, which are creating most of the new jobs in this economy, do not have that capability.

So, in a sense, not only are they at a disadvantage when it comes to access to capital, but also at a disadvantage when it comes to an access to workers skills. So, I think it is an issue.

Mr. BROOKS. May I take a cut at that, sir? I have served in the past as chairman of a 2-year study on what about technology education in public school systems. In a major metropolitan area we found the following: The children are not prepared to study math because there are no role models exhibiting the attractiveness of a study in math. And we are all familiar with the case of, you do not want to do that; that is hard. That is behind us.

The problem is not so much the kids as it is our institutions. We found no guidance counselors who could encourage people to talk about manufacturing technology or careers because they did not know about it. We found teachers who studied math did not stay in the school system but they went to industry because, as a society, we have pushed down the social relevance and importance of science and math, and pushed it away.

Now, I earlier served on the board of visitors of a major college for a number of years. In order to get our students into the technical fields of these schools, we had to have remedial education for average graduates of high schools in good school systems.

The problem is more basic than that. We maintain that in many instances it all has to do with what we proclaim as the social significance of work, and employment, and position in society of those who engage in manufacturing and scientific or technical employments. We are perfectly happy to have good auto mechanics, but there are no heroes publicly proclaimed from manufacturing.

How many of us older people would eagerly encourage our grandchildren or children to seek a career in manufacturing. It is part of the problem. And so we need to do something about it, and there is lots to be done.

The CHAIRMAN. Senator Rockefeller.

OPENING STATEMENT OF SENATOR ROCKEFELLER

Senator ROCKEFELLER. Thank you, Mr. Chairman. I apologize for being late.

I would ask this of any of you but I suppose, Mr. Prestowitz, of you certainly. And that is of linkage between trade policy and technology policy.

Now, this amazing thing happened wherein on semiconductors the Japanese went to 20.2 percent. I think what is interesting and what is much more important is, what will the next quarter show and the quarter after that. But the point is that we got in. But that has been a long fight, and Bob Galvin and a lot of other people could talk about that, and so could you because you worked with that.

You can have technology policy working. You could pick up the Washington Post several days ago and read this extraordinary story, Mr. Carlisle, of a businessman who started to reeducate his entire workforce, which was not very large, and their productivity went sky high and morale is incredible.

You can spend \$25 billion a year reeducating the new workforce, and maybe that is a better thing to do than trying to do it in public school because at least it is specific to the needs of the industry. And you can encourage technology, and you can make people engineers, and you can do all the right things on technology. You can have venture capital, encourage new ideas, but unless you can get it sold overseas, that also affects technology policy, or at least the results of technology policy.

And I think it ought to be reasonably clearly stated by one of the three of you, if you agree with it, that there is not much point in having a successful technology policy as hard as that might be and as good as S. 4 is, if it is not accompanied by a substantial trade policy.

Mr. PRESTOWITZ. I could not agree more. I mentioned that in some earlier comments. Let me reiterate it. The phenomenon of developing technology, winning Nobel Prizes, and losing industries is common to the U.K. and the United States. Both the U.K. and the United States have been characterized by laissez-faire trade policies, and essentially laissez-faire technology policies, but substantial investment in basic research. And our experience has been that we do pretty well on basic research. We get all the Nobel Prizes, and we lose all the important industries.

I think two things are operative which are very important. One is that if you engage in a lot of effort to develop a technology, in today's world that typically involves substantial investment. In order to get a return on that kind of investment, it is necessary to be able to amortize the investment over world markets. If you cannot get into some of the major world markets, you will not be able to amortize the investment, therefore you will not make the investment.

The second thing that happens is that we have had many experiences over the past 30 or 40 years in which, in critical industries, foreign markets have been closed and foreign governments have targeted those industries, and as a result have come into the United States using trading practices of questionable legality and fairness, and have driven U.S. industries out of the business.

And we are now in a situation in which if a foreign government announces, or even if a foreign industry in one of those countries announces that it is going to go into a particular area of technology, the risk of investment in that technology for private entrepreneurs in the United States becomes prohibitive, and they simply do not go into that area because they say, "Oh, you know, we know what happened to us in televisions and we know what happened to us in VCR's. We are not going to do that again," and so they stay away. And so the result is that you can train television design engineers, but where are they going to get jobs, because we have not had a sensible trade policy.

So, let me reiterate that and strongly support your position. May I be excused, Mr. Chairman?

The CHAIRMAN. Yes sir, Mr. Prestowitz. Do you have one more?

Senator ROCKEFELLER. I do, but it does not have to be to Clyde.

The CHAIRMAN. Thank you very, very much for coming back. You have done the committee a favor, and you are right on target on the last particular comment because we had before this committee the comment last October, when the census reported the age group in America between 18 and 24, 73 percent of that age group could not find a job or if they could, could not find a job out of poverty. And so we are talking about that age group preparing themselves for the marketplace and how we have to reeducate them. We have got to reeducate the marketplace also to get prepared because we are making these big graduate talks, and you are the future and everything else, but we have not provided any future at all for them.

Senator ROCKEFELLER. For either of you gentlemen, it is hard to get money, and let us look at it from two points of view. Modern business says that you have got to have inventory just in time. Banks use inventory as what they want to collateralize. If you do just in time, by definition you cannot have much to collateralize, so banks do not loan.

Now, that is sort of a silly situation. I would like you to comment on that, No. 1.

No. 2, venture capital. Lots of good ideas exist. It used to be that you could have a good idea, and then you could go to a venture capital fund, you could go to a bank and people would say, good, we will go with that. We are not sure it is going to work, but you are an interesting person, you have a track record, and bring it back to us when you have got something to show and we will take a further look at it.

Now, nobody wants to do that. Venture capital people are very cautious, risk averse, banks most definitely so. So, now you have really got to prove to somebody that your experiment, your idea is going to be commercially successful, practically give them a demo which, of course, you cannot do before you will get money. So, nobody gets money.

So, here we are hurting ourselves again, which is obviously then why the Japanese and others who are, not maliciously, but they just come in, quite understandably, and say "Good, we will be glad to buy a position in your idea and your company and, by the way, we will get the technology in return."

One of things I want to see passed by this Congress, which I must say the present administration, as much as I like it, has not been very encouraging about, is the idea of a venture capital fund which I would tend to aim more toward critical technologies. And there would be some Federal money in it, there would be some private money in it. But all the people who made the decisions about where the money would go or not go would only be private, no Federal person would be involved in that, so it would be entirely private. And it would be try and supplement the idea that there is some venture capital money and that presumably new ideas as well as good technology and good trade policy—it all adds up at all counts.

One, the Clinton administration has not been exactly jumping up and down about it. And I am saying that so that they can hear me. Second, the business community is not very pleased about it, or apparently is not, because they say whatever Government touches it ruins.

On the other hand, we are not coming up with new ventures and new ideas, and we are not training a generation of people who are instinctively hungry and brought up to know that somewhere they are going to get a reward if they are intellectually hungry, and bright, and imaginative.

So, my second question is what about that situation? Why are we so risk averse? And is the idea of a venture capital consortium which is funded by Government and private industry, but only decided upon by private industry and private people, only decide by them, is that really all that dangerous?

Mr. CARLISLE. I would like to respond to that, Senator Rockefeller. I have had quite a bit of personal experience with venture capital. I have raised about \$31 million in venture capital to finance my company, my brother is in the venture capital business. So, I have had quite a bit of experience in that.

I think that it is a critical issue. We have seen venture capital drop dramatically from, as I mentioned in earlier statements, some \$4 billion a year in the mid-eighties down to about \$1.4 billion a year now. And, in fact, venture capital has been the vehicle that has essentially funded applied research in the United States. It has been the thing that, in many cases, has gotten the ideas out of the universities in the areas of biotechnology and, in my case, in the area of robotics and in many other examples.

As that has fallen off and we have not replaced it with any other source of applied research funding, as is contemplated in the ATP program, for example, we have seen a real gap in our ability to get ideas out of laboratory and commercialized. So, that has been a real problem.

I think the issue, or perhaps hesitance or concern on the part of entrepreneurs with respect to the Government helping, if you will, has been the history perhaps associated with some of the SBA activities.

I spoke to one venture capitalist about this proposed feature of S. 4, to provide venture capital funding, and he told me that he had started his venture capital business as an SBIC, essentially administering funds from the Small Business Administration. And he did

that for one fund and then immediately stopped doing it and never wanted to do it again.

And his reason was he had to file so much paperwork with the SBA, and it took such a long period of time to get decisions made, and not only did he have to file the paperwork but his portfolio companies had to file paperwork as well, and continue filing paperwork even after they had been funded.

So, in my written testimony I encourage the idea of venture capital funding being made available by the Government. I strongly encourage the idea, as you have suggested, of having it administered by these licensed technology investment licensees and not having the Government involved in the decision process.

In speaking with another venture capitalist, he told me that if that were the case, if he could get Federal funding in the same way that some State funding is provided now—the State of Michigan, for example, has a venture capital investment fund and they provide funds to venture capital investors and they administer those State funds.

He said, if he could get the Government funds at a lower cost or a lower expected return, he would be delighted to administer those at a lower management fee because it would allow him to leverage his funds that he was raising from institutions, and would allow him to make more investments and better investments.

So, I think the success of this idea really depends on how these funds are administered. And if they are delegated to effective fund managers and the Government is not involved in the decisionmaking process, then I think it can be a very good idea.

Senator ROCKEFELLER. Thank you.

The CHAIRMAN. On that point, Mr. Carlisle, we had former Secretary Harold Brown appear before the committee last year and he said, "Now what really needs to be done is you folks in Government produce the \$5 billion fund and let us in industry administer it"—something like a reconstruction finance corporation.

I do not think that is going to be done. I think that was in despair. That was under the previous administration, knowing that they were not going to ever trust anybody in Government, whereas now we have folks very positively interested in this program and interested in the small business loans, and interested in developing the various technologies and what have you.

But, do you have a comment? Either one, Mr. Brooks or Mr. Carlisle, do you have a comment? Are you familiar with Secretary Brown's civilian technology corporation, as he wanted to call it rather than an RFC, and put \$5 billion in it, and then from there on they would run with it?

Secretary Brown is very impressive and quite a salesman, but if he can sell that—

Mr. CARLISLE. Mr. Chairman, I am a believer in showing success before we spend a tremendous amount of money on things. I think S. 4 used the phrase, "pilot programs," for some of the funding that was contemplated.

I endorse that approach, and I think that if we can show success with modest amounts of funding in these pilot programs and find administrators of these funds that are efficient—endorse them and are enthusiastic and effective, then I think we could make the ar-

gument that we should expand these programs, but I would be hesitant to throw a huge pot of money at something without a proven mechanism to show that it is going to be effectively utilized.

The CHAIRMAN. Do you think the provisions of S. 4 and its financing provisions are on target? In other words, that is a good first step, that is a good start?

Mr. CARLISLE. I think it is a good start. I am not familiar with these specific mechanisms. S. 4 discusses licensing these critical technology investment corporations. I do not know exactly what those are, so I would be happy to talk with the staff about that, but the general approach of having an experienced investor that has got the decisionmaking authority to make the decision in a couple of months as opposed to having the Government involved I think is the right approach.

The CHAIRMAN. Well, let me on behalf of the committee thank you, Mr. Carlisle, and you, Mr. Brooks, for coming back this afternoon. We appreciate it very much, and our lead witness for the entire hearing was the distinguished Senator from Nebraska, Senator Bob Kerrey. We want to hear from him at this time.

Senator ROCKEFELLER. And just speaking as a junior on this committee I really appreciate very much your staying. We do crazy things in the Senate. We have specialized in that in the last 36 hours, and we disrupted a lot of your schedules, and to everybody here I personally am extremely grateful. It is one of the reasons why only 14 percent of the American people think that the Congress has any wits about them.

Mr. CARLISLE. Thank you very much. We appreciate the opportunity.

The CHAIRMAN. Well, the majority sent us back here in November, but in any event, Senator Rockefeller is the chairman of our Science Subcommittee and has been a leader in this whole thing. He is not junior, he is a leader for us, and I appreciate him coming back this afternoon.

Thank you a lot, Mr. Carlisle.

Senator Kerrey, we apologize to you, and we would be delighted to hear from you at this time, and then when you have completed, we invite you again, as we have had you, to sit with the committee and examine the witnesses along with us.

STATEMENT OF HON. ROBERT KERREY, U.S. SENATOR FROM NEBRASKA

Senator KERREY. I appreciate that, Mr. Chairman.

First of all, I am here to express my appreciation for this committee's efforts in developing S. 4. I believe the National Competitiveness Act of 1993 deserves a very high priority consideration by the Congress. I hope that it gets enacted quickly.

I hope the administration would sign it into law, and as several of the witnesses have indicated, I hope it is not only implemented but that we establish some benchmarks and make sure that it is implemented in a fashion that produces the desired result.

On that point, Mr. Chairman, I would ask unanimous consent—I am just going to submit my entire statement.

The CHAIRMAN. It will be included, and you can highlight it as you wish.

Senator KERREY. Lest I sort of wander around in all the technological jargon and get lost here, the most important thing about this act and the reason that I am so enthusiastic about it is that it responds to the most important need we have in America today, which is to create new jobs.

Whether I am in rural Broken Bow or in Omaha, NE, it is the No. 1 issue that I hear discussed in town hall meetings and though it might get reflected in concerns about the economy and concerns about businesses, about being regulated, about tax levels and all that sort of thing, it is the job that matters most of all to Americans today, and I believe this act will help us become more competitive and help us become more competitive by allowing businesses and entrepreneurs to create new jobs.

I also want to point out something else, Mr. Chairman and members of the committee. My observation is that there is more insecurity in the workplace today than—at least that I have seen in my adult working life.

That is to say, there are more people who are working in the 97 million or so in the private sector who fear that they may lose their job tomorrow than at any time that I have witnessed it. There is a growing anxiety out there.

There was a recent article in the Wall Street Journal that described the four horsemen that are going through the workplace. One is international competitiveness that now threatens not just manufacturing jobs but service jobs as well, increased automation—good news, we by technology become more automated, bad news we lose jobs in the process. Those who remain are apt to have never had it so good. Those who lose their jobs are apt to have never had it so bad.

It is not only happening in the manufacturing sector, obviously it is now happening in the service sector, and third, demand-driven downsizing. IBM bets on mainframes, they lose the bet. Sears is downsizing, defense cutbacks forcing Boeing and other manufacturers to cut back. Base closings, the most dramatic demonstration of how this downsizing affects our economy.

The fourth thing, Mr. Chairman, members of the committee, there is an increasing tendency on the part of employers as a consequence of the cost of health care, the cost of retirement, the cost of workmen's compensation, to turn to contract, temporary part-time help. The best example I have heard lately is Bank America, 28,000 employees—60 percent of those employees have fewer than 20 hours a week.

So, there is a great deal of insecurity out there in the workplace, and what I would like to do is in addition to inserting into the record and saying once again that I believe this bill is extremely important and will help American businesses become more competitive, that it will allow us to go back to our communities and say we are doing something about the need to create jobs, obviously it needs to be coordinated with trade policy.

As both the chairman and Senator Rockefeller alluded to earlier, we cannot be blind to what other nations in this world are doing, but if we are going to create jobs in America, we are going to create them as a consequence of our own effort.

In my own questioning, the question that I asked earlier of the three, not only distinguished but kind witnesses to stick around this afternoon, the question that I asked referenced a move on the part of the State of New York to say that their curriculums now, and again, not just for people, students that have decided they want to go into the workforce instead of college, but all students in New York State, under consideration by the board of regents will be required to have as a part of their schooling some workplace experience, and they will be required as part of their curriculums development to acquire the skills of working.

It is a very important thing, Mr. Chairman, for us to just ask the question, do we have much confidence—what kind of confidence do we have that the 2 million people we are going to give diplomas to here in another 5 or 6 weeks that those people are going to be able to go into the workforce, the workplace of today, that they are going to have the requisite skills over their lifetime to survive in a changing marketplace?

My guess, Mr. Chairman, if you get 1.4 million or so that are going to go into the workforce, my guess is a full one-half of those young people are being fooled to believe that that diploma is worth something. It is apt to be that they are not going to be prepared for the kinds of jobs that they would like to have in the workplace today. You have got to not just be able to lift the load, and it seems to me that we have got to address that.

What I am here today to talk about more specifically is a piece of legislation I introduced called the Electronic Library Act of 1993. I am urging the committee's consideration of it as a possible amendment to this piece of legislation as a distinct title, as title VII.

I have used the library model not because I am trying to build libraries where people go check out books, but because in fact the existing institutions are inadequate to be able to handle the pressing challenge that we have today of training our people to handle technology, of answering questions about how we are going to get the network in place, and how we are going to get not just the high bandwidth, very high-cost network, but some of the low-cost, low-technology networks that are out there today.

Our people need a great deal of training. Mr. Chairman, I have seen what some of this new software can do. It is a very powerful educational tool, almost against what most of us have concluded when it comes to communication technology. This technology can actually increase the capacity to be able to read, to write, to do math, to do science, to do languages.

It is a very powerful educational tool, and when I say counterintuitive, Mr. Chairman, a lot of us have experience with some of the old technologies, and in fact a lot of us have reached the conclusion that we were fortunate to have arrived at—in the age of television late in life so that we did not have our reading skills and our writing skills unnecessarily impaired as a consequence of excessive exposure to television, and so we tend to think perhaps this technology will make things worse.

I believe very strongly that it can make things better, and in urging the consideration that one of the problems we have got is that at the State level there are not the institutions prepared to be able

to get the job done. Many of these institutions, No. 1, the first value is self-preservation, and they get very nervous with technology such as this that can threaten their existence, or at least require them to become more competitive and more responsible and more accountable.

The idea of a State-based library system in short is not that we necessarily by any stretch build buildings where people go check out books. I think the fifth phase of telecommunications will have us in a situation where the libraries will be much more of a virtual library than they will a physical building.

Nonetheless, there is archiving requirements, there is training needs, there is networking questions, there is real partnerships that can be formed not just for the private sector but also with some of our Government entities—the Department of Energy, the National Center for Atmospheric Research, the National Aeronautics and Space Administration, all of which have spectacular technology.

In fact, Mr. Chairman, I would urge your committee to consider that with three-fourths of the supercomputers being owned by the Federal Government itself, that these tools are sitting there as natural partners to be used by parents, by teachers, by business leaders that are trying to bring this communication technology into our lives so that we learn better, so that we are creating jobs, so that we are making our businesses more productive.

I apologize for sort of the machinegunning and going through there rapidly. I know you are on a tight time schedule.

Again, I would close by saying, Mr. Chairman and to the committee, I believe S. 4 is crucial in 1993. Jobs and work is the most important—are the two most important issues that I hear people talking about all the time. We have got to respond to that.

If all we do is yak and run our mouths about deficits, if all we do is debate budget resolutions, if we do not prove up with our capacity to be able to help the private sector create jobs, the American people will drop our numbers from 14 percent, Senator Rockefeller, to a number even lower.

I believe S. 4 is the most important piece of legislation that I have seen yet introduced this year, and I hope that we pass it very, very quickly so the American people can enjoy the benefits.

[The prepared statement of Senator Kerrey follows:]

PREPARED STATEMENT OF SENATOR KERREY

First, I want to express my appreciation to the distinguished Chairman of the Committee for his work on S. 4 and for allowing me to testify today.

Mr. Chairman lest I wander around and get lost in a technological forest of jargon, acronyms and odd phrases let me be clear: America needs this bill because we need jobs for our people.

Americans want and need jobs. From rural Broken Bow to urban Omaha I hear more about the desire for jobs than I do any other issue.

Mr. Chairman, I also hear something else: Americans are more afraid they may lose their job than at any time in my adult life. I insert this at the beginning because we must acknowledge and accommodate this fact: As we develop and apply technology to create jobs, some less productive jobs will be lost. Unless constant job training is technology's point man, we will produce as many new have-nots as we do haves.

I strongly support S. 4 because I know it will create American jobs, help raise our standard of living by improving our industrial competitiveness, providing assistance in the development of the key technologies of the 21st century, improving the

quality of life in America. S. 4 continues a century-long advance to better wages and greater economic prosperity.

There are three provisions which are guaranteed jobs builders:

1. The expansion of the Advance Technology Program, which was established under section 2B of the National Institute of Standards and Technology Act. A closer relationship between DARPA/ARPA and other federal research and development agencies will help America keep her technological edge.

2. In addition, as a small businessman and former Governor of Nebraska, I understand the potential of the State Technology Extension Program. Particularly important is the effort to develop manufacturing and technology extension programs to support rural manufacturers.

3. The Information Infrastructure and Technology Act, which is incorporated as Title VI will accelerate the development of high performances computing and networking efforts. Not only will this section create jobs but it will also improve the quality of the basic and applied research needed for technology development.

Mr. Chairman, let me talk about the need for training and what we can do with this legislation to accommodate that need. As I said, the good news of technology often produces bad news of increased automation and decreased jobs. The work place in America is being visited by four horsemen, as Ralph King of the Wall Street Journal calls them. The four are international competition, demand-driven downsizing of large corporations, a movement to part-time contract work, and automation. We make a big mistake if we proceed with S. 4 and do not understand this wrenching transformation.

Thus, while I believe this technology and infrastructure will stimulate a new generation of information entrepreneurs and jobs, it is in training and education where its greatest promise resides. To put things in perspective here are some living facts:

1. In 6 weeks two million high school students will graduate and be given diplomas. For the 1.4 million who try to enter the work force a very large percent will discover their diploma isn't worth very much.

2. Of the 90 million Americans holding private sector jobs it is estimated by some studies that as many as 40 million may be under trained.

Mr. Chairman, for years Nebraska has been a leader in educational television and distance learning. I have tried to support and recognize this efficient means of extending the reach of learning. However, new information technologies give us the means to overcome some of the limitations of the broadcast medium. The most exciting is the parallel advances in storage, computing, imaging, and transmission technologies.

The Internet, one of the Federal government's most democratic investments, is the best manifestation of these changes. The Midwest Center for the National Science Foundation's Internet is located in Lincoln, Nebraska, and we have undertaken a number of efforts to connect both elementary and secondary teachers and students to Internet.

I know that this committee has heard about both the exponential growth in the number of Internet users and the potential for both Internet and the follow-on National Research and Education Network. We talk about a future in which the text of an entire encyclopedia can be transmitted in a second and in which we can browse through art collections of our choice throughout the world. It is all very exciting and the beginnings of it are here now.

In the Age of Information, the information-rich will be those who can obtain, process, store, retrieve and disseminate the data they need. These capabilities can make us more competitive and productive. They can improve the quality of our lives. They can contribute to our educational and training efforts. Indeed, they can revolutionize education, health care and manufacturing in much the same way that another "modern" invention of its time—the Gutenberg press—revolutionized another time.

We are on our way with the so-called information highway. The digitalized data and Grand Applications envisioned by Title VI will move us ahead. I hope we can enact and implement that Title promptly.

Mr. Chairman, I have developed and introduced legislation which I believe will reinforce this activity and which will also give Americans the capacity to educate and train themselves. The legislation is the Electronic Library Act of 1993. Frankly, I wrote the bill so that it could easily be attached to S. 4 and I sincerely hope this committee will give it serious consideration.

The Electronic Library Act of 1993 will serve several purposes. Most important, the electronic libraries it would authorize to be established can serve as focal points for bringing together the networking capabilities of the Internet/NREN and the digitalized data and applications envisioned by Title VI. They can demonstrate what is available now and help create the vision for the future. They can provide the outreach, training and support services which are so necessary.

These would be libraries in the true tradition of the American public library; they would provide universal access to digitalized materials. A more modern description might identify them as information or data supermarkets, where the hardware, software and old-fashioned advice on how and what to choose would be available. The "librarian" would be well-versed in how to network, what information could be accessed and how to find the data one wanted.

The idea is to amass in a single access point the entire spectrum of tools necessary to function in an electronic information age and to permit access to those materials in a variety of ways from personal check out, to mail, to dial-in and advanced on-line capability.

Where once a person might have checked out a book, they could now check out materials or access them electronically. Where once a person might have looked at a card catalogue, they would now have new ways to search and retrieve and query electronically. Where once a person might have asked a librarian to recommend a book or periodical, they can now ask for recommendations on hardware, software and networking strategies.

Where once a teacher, researcher or student might have created a study guide or paper from written text, they can now create it from a variety of text, audio and video. Where once a person might have had to order under an interlibrary loan program, they could now pull up the information on their computer. Where once they might have had to go to a physical place, they could now obtain information from the home or school.

Such a system serves several purposes: it demonstrates and thereby hopefully creates both understanding and demand. Second, it provides expertise and support in what is often a bewildering variety of hardware, software and networking options. Third, it seems to make resources available to all, not just those who attend a school fortunate enough to be well-equipped or who can afford their own systems.

I propose these state-based libraries because I believe we need prototypes. We need to demonstrate the full potential of networking and digitalizing information. Most individual schools, school districts and even cities cannot afford to create a comprehensive electronic library. They may buy a few programs, have connectivity to several on-line services, do some search and querying, but they are not going to be able to assemble a large amount of hardware, software and networking capability, experiment with it, and make it widely available, much less provide the desired support and outreach. This is what the libraries envisioned by my legislation would do. Furthermore, it would do it in such a way as to bring together the vast and often competing interests in the telecommunications field.

Mr. Chairman, I say again that you and this committee are to be commended for proposing this legislation. America will be the beneficiary of your vision and your hard work.

The CHAIRMAN. Well you have got a tremendous grasp.

Let me ask you, with respect to the computer network, the schools, your experience in Nebraska and the very problem posed before this committee.

We have the telephone companies, AT&T and the Bell regional companies and everything, and they say, wait a minute, we have got the infrastructure, we are ready to build and do what you are doing. Let us perhaps provide for the research and help us with that, but do not superimpose a Government-constructed network.

Do you have a comment about that? It gives me some misgivings. I think what is really intended by the committee is research, but then Senator Gore at the particular time was talking about his interdefense highway, or superhighway of information, and you have had an experience, I take it, in Nebraska.

Senator KERREY. Mr. Chairman, I am not an advocate of the Government building a high bandwidth network, and I do not think that is the question you are asking. I would just offer as exhibit A to AT&T and the regional Bell operating companies and anybody else that is out there in the business the NSF/DARPA net, now Internet, as an example of in fact what Government can do at its best.

That network now is enjoying 15 percent growth a month. We expect to see a billion people on that network by the end of this decade. It is low cost, it is low technology—Senator Burns has a gentleman out in the State of Montana by the name of Frank Odads who is running the Big Sky network out there, and he can put a community on that network on the Internet for \$600 a year.

He says the amount of money that it takes to get that done, you can get it by recycling your garbage. It is not high cost.

I will say this about the industries that have been given special privileges to provide both long distance and local access. I think they have got to get this job done immediately.

By that, I mean very specifically one of the things that I think is very alarming today is to look at the difficulty that our schools have in getting on line. Very few schools have lines coming into the classrooms. An awful lot of schools still are not on the Internet. Kentucky is the only State in the Nation—the only State in the Nation that has all of its schools on the Internet at the moment.

Now, I believe that the RBOC's and AT&T an MCI and others could figure out how to get that done in 6 months, Mr. Chairman. Perhaps they are going to need some kind of an educational tariff that gets the job done.

My own view is that the old days of dial tone are apt to be behind us. It is apt to be another 5 or 6 years that the phone companies are going to be giving dial tone away as a consequence of the growth of enhanced services.

The enlightened RBOC's are asking for permission to compete at the local level. There is an urgent need for us, I think, as policy-makers to direct them to get our schools on the Internet and get them connected to these networks.

What I envision is all kinds of new communities of interest are going to build up out there on the Internet itself that will connect to one another as a consequence of interest. The old cartographers having to draw maps and define this political subdivision and that political subdivision I think are going to fall by the wayside.

In fact, I would say again for emphasis, one of the problems that I have that we have out there at the committee level right now is the existing institutions. The governmental institutions understand that the people themselves may rearrange the deck.

They may decide that this governmental entity is no longer needed. They may decide that they are able to go direct without the need for a wholesaler. They may find themselves selling services back and forth to one another, and that completely obliterates the need for us to collect taxpayer money and organize in the current fashion we have got.

So, I think the industry is correct in saying we do not need to build a high bandwidth network and own it ourselves, but I think if any time the industry comes forward and says Government ought to stay out of it altogether, they are ignoring our success, and they are ignoring their lack of success of using available technology to wire up and hook people today.

Mr. Chairman, I would say one last thing that I am concerned about when it comes to education. Prior to arriving in the U.S. Senate, I had an income in excess of the generous salary that the people now pay me for to be a Member of the Senate, so I had the ca-

capacity to afford to be able to buy the hardware and the software that I have in my home.

In the State of Nebraska, there are 13,000 homes out of 750,000 homes with incomes over \$75,000 a year. I stumbled there. It is \$75,000 a year, 13,000 homes out of 750,000.

We are developing an enormous means test in the marketplace right now of people that are able to buy as a consequence of income and assets while lots of folks sit out there to be able to purchase either the hardware or the software, and it is going to have—I think it is going to have a dramatic impact in creating additional haves and, regrettably, additional have-nots.

The CHAIRMAN. Well, we appreciate your leadership, and particularly your bill.

Senator Burns.

Senator BURNS. I want to thank Senator Kerrey for coming forward here, and that is what I wanted to hear. And may I be the first to be one of your cosponsors on this? I would ask the chairman that it might be added to this infrastructure. I do not want to slow it down, because I know how important it is to you, but I would recommend that it be made a part of S. 4, and you all will have to get together and figure it out with the proper hearings, and that is all I have.

We have been through the highlights of the bill, and I want to congratulate you for coming forward on that. And that is what I was alluding to yesterday when Senator Kerrey and I were down and looking at some demonstrations. I was really impressed on that.

Mr. Chairman, I just want to enter some stuff. I do not have any questions for Senator Kerrey. I would defer to my colleague from West Virginia. And this is not going to be a test in animal husbandry, by the way.

Senator ROCKEFELLER. Thank you very much for that. That is an inside joke, folks.

I wanted to first of all congratulate Senator Kerrey on his intensity that he brings to everything in terms of bringing computers and Internet in Nebraska schools, and West Virginia schools, and any other schools particularly in rural areas together. The faster that can be done the better.

I need also to apologize particularly to a person I care very much about in the room by the name of Brian Joseph, who is on the next panel. And I had arranged my schedule, obviously, so as to be here for the entire hearing, which was this morning. But now it is this afternoon and there is a large group in my office that the chairman of this committee is very anxious for me to spend high-intensity time with. And in fact I do have to go do that.

So, I not only apologize to Senator Kerrey, but I particularly apologize to the next panel, and particularly you, Brian, because this whole question of patient capital, and new research, and getting started, and getting the money for it, and all the hassle you had to go through to get Touchstone to where it is today.

I have got questions here that I am going to give to the committee, but will not be able to ask them to you, and I feel personally badly about that. So, I wanted to apologize to you, and to congratu-

late you, Senator Kerrey, and to apologize to my chairman. And on that sort of down note, I guess I will leave. [Laughter.]

Senator BURNS. Senator Kerrey, I was wondering—a question I was just reminded of from my staff that I should ask you. Would you be interested in joining us? You know, we realize that we can do some of these things, and in fact most all of these things, with just tweaking the policy a little bit, changing the policy of what different people can do.

And we sure would invite your help in that area because I know you have an interest in that area. And, by the way, we understand what can happen because if you go into the State of Montana, where we have two demonstrations going now and a third one going up—not demonstrations, they are being used. Two-way interact, high-density television in the classrooms. They are being used. They started out being used 1 hour a day and now they are being used 6, which is a testimonial that they will use that technology once it is there.

But they are being done by rural telephones under REC's that live outside the regulatory regime that the RBOC's live under. And so maybe a little low interest money, and changing the policies for some of these schools in order to get the equipment and tools, because they will use this new technology.

So, again, I want to be a cosponsor on your legislation. I think it is very forward thinking. You are right, it is low technology, but I think the usage will be very, very high.

And Mr. Chairman, I would ask that my full statement be put in the record. I also have some statements here—a statement from CEO's of 14 major corporations responsible for America's publicly switched network, and also computer systems policy projects that I think are very important and should be made a part of that record today. And I, too, am going to have to leave here pretty quickly.

[The prepared statement of Senator Burns follows:]

PREPARED STATEMENT OF SENATOR BURNS

Mr. Chairman, let me again congratulate you for your demonstrated leadership on high-tech issues with the introduction of this forward-looking bill, S. 4, the National Competitiveness Act.

Mr. Chairman, as I indicated at our first hearing, I do have some concerns with this legislation before us today—but, overall, and on balance, this is the appropriate direction for our government to be going in the critically important area of high technology.

As the first and only Republican to add my name as a cosponsor of your legislation, I want you to know that I welcome your leadership and look forward to working closely with you in moving this legislation and other bills on high-tech and telecommunications forward in the 103rd Congress.

Most significantly, in S. 4, Mr. Chairman—and the area I am, of course, most excited about—is Title VI of the bill. Title VI includes the language of S. 2937, which I cosponsored with Vice President Gore last year.

Today, I want to let the Committee know of my intention to offer an amendment to Title VI of S. 4 which will authorize programs to demonstrate and test advanced educational applications of computer technology in grades K through 12.

Additionally, I have a series of questions for our Bellcore and Microsoft witnesses concerning Title VI. I want to pick up where I left off with the questioning of Commerce Secretary Brown in determining the proper role for government and the proper role for the private, commercial sector in developing a National Information Infrastructure.

On that point, I ask unanimous consent to place in the record at this point the statement from the CEO's of 14 major corporations responsible for America's public

switched network. I also want to place in the hearing record the Computer Systems Policy Projects's report entitled "Perspectives on the National Information Infrastructure." CSPP is a group of 13 leading computer CEOs.

As I have stated many times before, Mr. Chairman, we are on the verge of a digital, multimedia, technological revolution. It is arguable that computing and communications technologies are the most critical enabling technologies being looked at today.

Let me note, however, a word of caution. At the same time we are moving forward funding programs to assist in research and applications for a National Information Infrastructure, we, as policy makers, must also develop a legal and regulatory framework for increased private sector investment—a framework which promotes fair competition, encourages innovation, allows for the involvement of all participants and industry segments, and insures universal access to all Americans. Moreover, this policy framework must also clearly delineate government's role from the private sector, commercial role.

By doing so, Mr. Chairman, we can ensure that the information infrastructure reaches its full potential—including better education for all children, better health care services, job creation and strengthened U.S. competitiveness.

Again, thank you, Mr. Chairman, for holding this hearing and for demonstrating continued leadership and vision in the area of technology policy.

The CHAIRMAN. Well, Senator Burns, you say it is just a little tweak of the policy. Even a puppy dog opens his eyes in 9 days. This crowd up here has taken 12 years, and we appreciate—

Senator BURNS. Well, I have only been here for one-third of those, but I appreciate your leadership on this, and we have worked our way through some storms and some windfalls.

The CHAIRMAN. Senator Kerrey, if you can sit with us we would appreciate it. We have got a real good panel here.

Senator KERREY. I always believe it is useful, before you recommend somebody do something, that you walk a little while in their shoes. And for the record, it is awfully hot out here, for those witnesses that are coming to this table. [Laughter.]

The CHAIRMAN. We purposely turn it up to move them along. [Laughter.]

We would ask Mr. Siegendorf of Hewitt-Robins and Mr. Brian Joseph, you folks to come forward please, right quickly if you do not mind. Dr. Priscilla Kilcrease, the Deputy Commissioner of Research of the Sponsored Programs of the Board of Regents down in Louisiana; and Dr. Robert Lucky of Applied Research at Bellcore, Red Bank, NJ; and Dr. Nathan Myhrvold from Microsoft.

I am going to follow the listing here except with one exception, an alteration because Dr. Priscilla Kilcrease has to leave in a little while. So, Dr. Kilcrease, we really appreciate—and each of you. The committee is indebted to you, and we apologize once more, but I think you understand.

Dr. Kilcrease.

STATEMENT OF DR. PRISCILLA KILCREASE, DEPUTY COMMISSIONER FOR RESEARCH AND SPONSORED PROGRAMS, BOARD OF REGENTS OF THE STATE OF LOUISIANA

Dr. KILCREASE. We certainly do understand, Mr. Chairman. I appreciate the opportunity to present this testimony on behalf of the commissioner of higher education in Louisiana, Dr. Sammie Casper, and to express our views on the importance to the Nation of the passage of S. 4, the National Competitiveness Act of 1993.

We believe that the greatest impact of the National Competitiveness Act will be the recognition that the U.S. advancement in most economic sectors requires the development of an infrastructure—an

environment—in which automation is an integral part. We also believe that the directions suggested by S. 4 are absolutely necessary for our national economic survival.

A key to regaining our momentum in world markets is to focus on rebuilding and upgrading our Nation's manufacturing infrastructure. It would appear that U.S. industry is still striving for profit maximization, while its major competitors strive for market share maximization.

In our opinion, the proposed legislation is an excellent start in the proper direction to correct this loss of momentum. We believe that the critical technology needed to revitalize our manufacturing infrastructure is in the area of computer science and engineering as applied to the manufacturing domain. The United States clearly holds the edge in this critical technology.

We strongly support the concept of NIST acting as a catalyst in this legislation in order to bring the collective experience and knowledge of industry to bear on the crucial need for increasing our manufacturing competitiveness. We also endorse the role to be played by the National Science Foundation in supporting this 10-year goal.

While strongly supportive of this bill, we offer some comments and observations on issues and potential obstacles that need to be addressed by those implementing this program. Some of the issues that need special attention are: the need for industry involvement; linking computer science and engineering to the manufacturing environment; the reluctance to use automation; and the need for funding sources for automation.

Relative to advanced manufacturing technology, the United States has the advantage of computing expertise, but we have not fully applied it in the manufacturing environment. As an example, an automated production line must be stopped and restarted when a machine drops or misaligns a component. This results in lost time and added costs and confusion. From our research experience in intelligent machines, we have available the technology necessary to adjust to such a local failure—that is, to pick up the piece and continue the manufacturing process.

There exists considerable active research, as well as a storehouse of past research results, that have not been applied in the manufacturing arena. This proposed legislation could serve as the catalyst necessary to get this knowledge into the applied manufacturing area.

With respect to national manufacturing technology testbeds, we urge careful review. The risks to businesses involved in the correct selection of equipment, computing, industry sharing of proprietary information, and timely integration of technology into the manufacturing process are but a few of the business community's concerns that must be addressed.

Finally, we believe that the national manufacturing outreach centers component of the bill should be of major benefit to smaller companies. When combined with the NIST regional centers for the transfer of manufacturing technology, a very valuable asset for U.S. industry could be present.

Louisiana is ready for manufacturing revitalization. There are three reasons that Louisiana has progressed in this area during a

period when the State faces many severe hardships. The first is the creation of the \$700 million Louisiana Education Quality Trust Fund, which ultimately will grow to a cap of \$2 billion. Most of the interest earnings and royalty income generated from this permanent trust are placed in its companion fund, the Louisiana Education Quality Support Fund, or the Support Fund.

The Louisiana Education Quality Support Fund provides about \$25 million annually to support competitive research in higher education in Louisiana. The existence of the support fund makes Louisiana the highest ranking State in the Nation in State support of competitive research, a fact not widely known in the national research community.

An additional stimulus to the Louisiana research community—and, I might mention, a wonderful stimulus to research in South Carolina, Montana, and other States as well—has come through the support of the Congress in the form of “bootstrap” programs at various Federal agencies, known as Experimental Programs to Stimulate Competitive Research, or EPSCoR.

The third reason for Louisiana’s progress is the presence of a high-quality research community in the disciplines most closely related to this legislation. In particular, the formation of the Louisiana Consortium for Computer Science and Engineering has provided added strength to our research community.

Louisiana has developed advanced manufacturing for apparel manufacturers. For example, the Textile Apparel Computer Integrated Manufacturing Center at the University of Southwestern Louisiana works with the Center for Advanced Computer Studies to cooperatively identify the research issues and programs in manufacturing. This center is recognized as the major activity in the Nation that supports this industry.

In the area of intelligent machine development, seven universities in Louisiana have formed a research cluster funded under Louisiana’s EPSCoR program, known as the Louisiana Stimulus for Excellence in Research, or LaSER. For the past year, there has been a concerted effort in Louisiana to develop and design a high-performance computer network for internal use, as well as for connectivity between Louisiana and the rest of the Nation and the world.

Our detailed testimony describes Louisiana’s advances in the areas of automated manufacturing and high-performance computing at numerous Louisiana universities, such as: one, the Center for Advanced Computer Studies at the University of Southwestern Louisiana, USL; two, the Advanced Computation Laboratory at the University of New Orleans, UNO; three, several labs including robotics research, software engineering, concurrent computing, and the Center for Advanced Microelectronic Devices at Louisiana State University; four, active research in high-performance computing and algorithms at Tulane University; five, the Louisiana Tech Manufacturing Systems Engineering Research Center; six, research in the area of expert systems and neural networks at Southern University; and, seven, work in high-speed networking at Northeast Louisiana University.

A recent and innovative project also funded under the LaSER/EPSCoR program will extend the use of the VLSI design and test-

ing facilities USL and UNO statewide. Louisiana is also attempting to bring the national research and education network to elementary and secondary education through the development of wireless modems, an emerging technology.

Through the cooperative efforts of the United States, the State of Louisiana, and its institutions of higher education, we believe the climate is ripe for the development of our own statewide manufacturing center. The passage of S. 4 and the subsequent expansion of the Advanced Manufacturing Technology Development Program will, we hope, provide an opportunity for Louisiana to develop in this regard.

In conclusion, we would like to thank the honorable members of the Committee on Commerce, Science, and Transportation for affording us the opportunity to present you with this testimony. We wish you our best in your weighty deliberations, and we are confident that the fruits of your efforts will benefit not only Louisiana, but the Nation and, indeed, the world as a whole as the United States regains its position of leadership in world manufacturing.

Thank you, Mr. Chairman.

[The prepared statement of Dr. Kilcrease follows:]

PREPARED STATEMENT OF DR. PRICILLA KILCREASE

Mr. Chairman, we are grateful for the opportunity to appear before this Committee to express our views on the importance to the nation of the passage of the National Competitiveness Act of 1993.

As we have discussed the contents of this legislation with our colleagues throughout Louisiana and across the nation, we believe that we speak not only for the Louisiana Board of Regents, but also for a broad coalition of researchers, both in our universities and in industry, for other officials of our state government concerned with the role of research in economic development and national competitiveness, and with ordinary citizens throughout the nation who understand that the key to our national economic growth is the revitalization of our research and development sector.

We believe that the greatest impact of the National Competitiveness Act will be the recognition that our advance in most economic sectors requires the development of an understanding that success in the twenty-first century depends essentially on the construction of an infrastructure, an environment in which automation is an integral part.

We further believe that the debate engendered by the National Competitiveness Act, together with the attention that has been drawn to this issue by the President, in his February 22 policy statement, will bring to the public the understanding that the directions suggested by S. 4 are absolutely necessary for our national economic survival.

In the course of this presentation, we wish to discuss a number of areas, in particular:

- Issues in Advanced Manufacturing Technology
- Louisiana's Readiness for Manufacturing Revitalization
- Louisiana's Thrust In Advanced Manufacturing For Apparel Manufacturers
- "Intelligent Machines"
- Development of the Louisiana High-Speed Computer Network
- Louisiana Higher Education Efforts in Automated Manufacturing and High Performance Computing
- Bringing the National Research and Education Network to Elementary and Secondary Education
- Benefits to Louisiana of Senate Bill 4
- Final Comments

ISSUES IN ADVANCED MANUFACTURING TECHNOLOGY

Title II: Manufacturing: The statement has been made: The 20th Century belongs to the United States. We prospered through the collaborative development of our national infrastructure, we had access to ample resources, we provided the lead in the development and applications of technology, we dominated world market shares, we

dominated in space exploration, we remain the single superpower in the world. However, productivity advances of our international competitors raise questions about our dominance, and maybe even our competitiveness, in the future. An articulate example of these problems is noted in Lester Thurow's recent book, *Head to Head*, which states: "Do we have problems? yes; Do we have solutions? Probably, if we discipline ourselves to clearly identify them, and to cooperatively address them."

A key to regaining our momentum in world markets is to focus on rebuilding and upgrading our nation's manufacturing infrastructure. Since the middle 1970s, it has been clear that U.S. manufacturing has been drifting, losing its edge in R&D, losing market shares to high quality and less expensive products from abroad (e.g. automobiles, aircraft, clothing, etc), and abandoning other traditional manufacturing areas (e.g. consumer electronics, manufacturing machines, etc). It is clear that in many industries US companies have not adjusted to global market changes and productivity advances of their international competitors. It would appear that US industry is still striving for "profit maximization" (short term goals), while its major competitors (e.g., Japan, Germany) are after "market share maximization" (long term goals). As a result, the U.S. investment in its future, due to its R&D effort and manufacturing infrastructure improvements, has been much too meager. Unfortunately, our competitors have taken the long term view and have invested in new manufacturing technology, new processes, new manufacturing paradigms, and quality enhancing methods. These actions by our competitors have led to a very skilled workforce for their nations, and put the U.S. at a clear disadvantage.

In our opinion, this proposed legislation is an excellent start in the proper direction to correct this loss of momentum. It appears that the elements of technology necessary to attain the 10 year goal of this bill are available, but we need an integrator and catalyst to regain our lost momentum. While we applaud the role of the Department of Commerce in performing the integrating and catalytic function, we firmly believe that US industry must drive this effort, if it is to succeed. We also wish to point out that in our opinion, the critical technology needed to revitalize our manufacturing infrastructure is in the areas of computer science and engineering as applied to the manufacturing domain; we clearly hold the edge in this critical technology, but we must successfully exploit this expertise for the goals of this bill to be attained. Now, we would like to get much more specific in our response to this bill.

Subtitle A: Manufacturing Technology And Extension—After careful review of the provisions of the Bill, we are in agreement with the manufacturing technology goals contained therein. We support the designation of the Department of Commerce as the lead agency, working in concert with other Federal agencies. We strongly support the concept of NIST acting as a catalyzing agent in order to bring the collective experience and knowledge of industry to bear on the crucial need for increasing our manufacturing competitiveness. We endorse the role to be played by the NSF in supporting this 10 year goal.

We are in strong support of the goal that within 10 years this nation will be second to none in advanced manufacturing technology, and we offer some comments and observations on issues and potential obstacles that need to be addressed by those implementing this program:

1. **NEED FOR INDUSTRY INVOLVEMENT:** To be successful, companies (particularly large companies experienced in the use of cutting-edge technology) must become involved in this program. Some of the nation's largest companies are leading users of manufacturing technology in production of their products (semiconductor, airlines, computers, etc), and have their manufacturing processes finely tuned to their particular needs. New development is done as necessity in their manufacturing environment, and sharing of the technology they develop is not in their individual interests. This program must address this issue; the sharing of manufacturing technology for the betterment of the whole, at the potential risk of loss of competitive edge among one's peers.

2. **LINKING OF COMPUTER SCIENCE AND ENGINEERING TO THE MANUFACTURING ENVIRONMENT:** To date, not enough has been done to make use of the accumulated knowledge and experience of computing in the manufacturing environment. This problem has a historical base, which need not be repeated here. We have the computers, we have the software, we have the design/development methodologies, we have the networking, and we have the data bases necessary to solve manufacturing problems. Much of U.S. industry does employ some of these assets, but their utilization is nowhere near the level that is available with present computing technology. The simplest answer to the question "Why is this power not used?" is that there has not existed an effective catalyst necessary to bring together the

elements needed for a solution to this problem. This bill may provide the vehicle which is needed for this integration.

3. ADVANCED MANUFACTURING TECHNOLOGY: While there is a great deal of talk about what needs to be done in order to develop new manufacturing technologies, in reality not much is being accomplished. Clearly, our foreign competitors are forging ahead with new machines, new methods, and quality improvement mechanisms, all aimed at increasing quality, reducing cost, and speeding time from concept to product. It appears that this program, coupled with industry leadership, will allow the U.S. to employ its technological advantage in computing expertise to once again take the lead in manufacturing. We have the computing advantage, but we haven't fully applied it in the manufacturing environment.

As an example: an automated production line must be stopped and restarted (lost time and added cost and confusion) when a machine drops or misaligns a component. From our research experience in intelligent machines, we have available the technology necessary to adjust to such a local failure (i.e., pick up the piece and continue the manufacturing process). There exists considerable active research, and a storehouse of past research results that have not been applied in the manufacturing sector. This proposed program could serve as the catalyst necessary to get this knowledge into the applied manufacturing area.

4. RELUCTANCE TO USE AUTOMATION: While many large and some medium sized companies have found automation to be essential in remaining globally competitive, most smaller operations have been somewhat reluctant to employ any form of automation. The reasons for this reluctance usually center on high cost, lack of funding sources, fear of change, and lack of available qualified manufacturing personnel. These issues, which prohibit most smaller businesses from enjoying increased competitiveness due to automation must be addressed by this proposed program.

5. FUNDING SOURCES FOR AUTOMATION: Generally, sources of funding necessary for smaller companies to move to automation in their manufacturing operations are not available at reasonable cost. To assist these small companies to automate, sources of low cost business loans are imperative. Existing small business development centers (SBDC) could work in conjunction with the proposed manufacturing technology and extension service to develop business plans and seek business loans for small companies wishing to automate their manufacturing operations.

6. NATIONAL MANUFACTURING TECHNOLOGY TESTBED(S): This component of the proposed bill must be reviewed very carefully, and industry must be the major player in its implementation. The risks to businesses involved in the correct selection of equipment, correct selection of computing, industry sharing of proprietary information, and timely integration of technology into the manufacturing process, are but a few of the business community's concerns that must be addressed. The question of being able to incorporate sufficient flexibility into testbeds to assist a number of focused market sectors is of concern. An alternative approach could be to provide assistance to companies to improve the manufacturing technology they already possess, thus making a showpiece of their manufacturing technology operation to be shared with other industries, but allowing the company to keep proprietary what it must. Industry, however, may be reluctant to endorse such a concept.

7. NATIONAL MANUFACTURING OUTREACH CENTERS: This component of the bill should be of major benefit to smaller companies which are unable to employ appropriate expertise to improve their manufacturing competitiveness. When combined with the NIST Regional Centers for the Transfer of Manufacturing Technology, a very valuable asset for U.S. industry could be brought to bear on the problem. The aspect of concentrating on an industry sector is probably more important than the regional aspect of these Centers. Cooperation with similar programs ongoing in many of the States would provide an amplification of the key elements of this program.

In summary, we are very supportive of this bill. We suggest that this committee look carefully at the above seven issues and concerns. It is tremendously important that U.S. industry fully support the intent of this legislation, and that once it becomes law that they fully participate in attaining the stated goals.

Another reason we appear before you today is to point out not only that this legislation enjoys broad support in Louisiana, but also that the State of Louisiana and the higher education community of Louisiana have for some time engaged in research and policy directions that foreshadow the implementation of a national approach to our manufacturing revitalization.

LOUISIANA'S READINESS FOR MANUFACTURING REVITALIZATION

There are two reasons that we can cite that have allowed Louisiana to progress in this area during a period when the state faces many other hardships.

The first is a result of a timely resolution to a long-standing dispute between the states on the Gulf of Mexico and the United States in 1986, and the farsighted response to the resulting financial settlement by the Louisiana Board of Regents, the Louisiana Legislature, and the citizens of Louisiana to allow the creation of a trust fund, called the Louisiana Educational Quality Trust Fund. The interest from this trust fund is put into the Louisiana Educational Quality Support Fund. The LEQSF as it is commonly known, directs about \$25,000,000 annually to competitive research in higher education in Louisiana. The Louisiana Board of Regents in 1988 developed a ten-year Strategic Plan for the use of these funds, so that the entire research community in Louisiana is able to plan for their use of these funds on a ten-year basis. It should also be noted that the Board of Regents have been scrupulous in ensuring that all awards made under through this fund are made on a competitive basis, with the review process being conducted entirely by out-of-state scientists.

A fact not widely understood in the national research community is that the existence of the LEQSF makes Louisiana the highest-ranking state in the nation in state support of competitive research. Consequently, although this program has only operated for six years, it has already invigorated our research community, and, we hope, will serve as a model for states throughout the nation in defining their own research objectives and missions.

An additional stimulus to the research community in recent years has come through the support of the Congress in recognizing that States which have been less active in the past in the development of their research communities can benefit from a "bootstrap" approach from the national government. The adoption of this philosophy, and its realization in the form of the so-called EPSCoR programs, has been helpful to Louisiana in the development and maturation of its research community in research fields related to the missions of the National Science Foundation, the Department of Energy, the Environmental Protection Agency, the National Institutes of Health, and the Department of Defense. The various EPSCoR programs in Louisiana are operated by the Louisiana Board of Regents, through the vehicle of a Board-appointed committee, called LaSER (Louisiana Stimulus for Excellence in Research), with representation from all universities in the State as well as private industry.

A second reason for Louisiana's progress is the presence of a very high-quality research community in the disciplines most closely related to this legislation. In particular, the research community in computing-related areas has been most prominent in Louisiana's development. In addition to the individual strengths of numerous universities in Louisiana in this area, the largest departments in computing science and engineering decided two years ago to form a consortium to provide a multiplier to their individual strengths. Consequently, the Louisiana Consortium for Computing Science and Engineering (LCCSE) was formed. This Consortium has provided added strength to the research community, developing, among other objectives, a commitment to a research cluster development in intelligent machines, the development of one of the nation's broadest approaches to VLSI research and education, the development of a consensus in committing to a statewide high-speed network, and the support of collaborative, statewide research in two areas critical to the manufacturing sector: apparel/textile computer integrated manufacturing and intelligent machines R&D.

LOUISIANA'S THRUST IN ADVANCED MANUFACTURING FOR APPAREL MANUFACTURERS

The State of Louisiana has been very active in supporting an industry that is important to our region and to the Nation: the Textile/Apparel industry. The State of Louisiana in partnership with the apparel industry is addressing the technology needs of these companies, with the goal of regaining the world leadership role in this field. The State has invested in the Textile/Apparel Computer Integrated Manufacturing (CIM) Center at the University of Southwestern Louisiana since 1988. This Center works with The Center for Advanced Computer Studies (CACS) to cooperatively identify the research issues and programs in Manufacturing. The Center is recognized as the major activity in the nation that supports the industry, and is endorsed by the following organizations: American Apparel Manufacturers Association (the Central trade association for the U.S. apparel industry), the American Textile Manufacturers Institute, the U.S. Department of Commerce, and the Amalgamated Clothing and Textile Workers Union. Through these partnerships, the barriers to widespread integrated manufacturing processes are being identified and re-

solved. Additionally, the Textile/Apparel CIM Center provides outreach services to manufacturers advising them of the significant benefits available through integrated manufacturing implementations. It is possible that the State of Louisiana may choose to widen its partnerships in this area to include certain elements of this bill, which would benefit this industry and the State.

INTELLIGENT MACHINES

Seven universities in Louisiana have formed a research cluster, funded by the LaSER program, in the area of intelligent machine development. Implicit in the concept of the development of intelligent machines is the understanding that such machines will be required to receive and process sensory inputs, and act intelligently on those inputs. Thus an intelligent machine could be, for example, a mobile robot, or a manufacturing system that must make process control decisions, or a meteorological computing system that must analyze vast amounts of remotely-sensed data.

For most of the uses of the machines the cluster envisions, there is a necessity to receive and analyze intelligently and efficiently sensory information [and to do so in a highly parallel manner]. In many cases, this will be visual information; in other cases, the information may be sound, or seismographic, atmospheric, or other image data that has as characteristics: (1) the quantity of data to be analyzed is vast (sampling sound at compact-disk quality requires storage capabilities of 44 kilobytes per second, or 158 megabytes for one hour of data); and (2) the problem of analyzing or recognizing images from a scene of visual or auditory data is extraordinarily complex.

Central to the development of intelligent machines is the objective of developing techniques for the intelligent analysis of this data and decision-making related to this analysis. [The resulting embedded real-time control models may remove a major barrier to widespread use of intelligent robotic machines.]

Most of the promise in research in intelligent systems requires implicitly a study of needed, vastly improved computing platforms on which this computation can take place. The "supercomputer" of today has a number of limitations in its architecture that make it simply unsuitable for the kinds of machines we hope to develop. Nevertheless, the computing requirements for intelligent machines require computing power that is beyond most current supercomputing capability. Thus of necessity we must develop computing platforms for these machines using parallelism. A parallel computer is defined as one that contains not one, but many processing elements. Each processor or processing element should be capable of doing all of the tasks that a normal processor can perform; thus the speedup occurs not because of the power of the individual processor, but because each processor can work independently or in parallel with the others.

A leading problem in the development of parallel computing is the necessity to develop a new philosophy and paradigm for programs and program language development. There are difficulties beyond the normal ones associated with program development that involve the arrangement of processors (the processor topology), communications between processors, and the capabilities of individual processors, and synchronization between processors. A good deal of research is being carried out in this area in Louisiana by members of this cluster.

DEVELOPMENT OF THE LOUISIANA HIGH-SPEED COMPUTER NETWORK

There is a race going on between transportation and communication, and whichever one wins will make the other unnecessary.—Andrew S. Tannenbaum (1981).

For the past year, there has been a concerted effort here in Louisiana to develop and design a high-performance computer network, both for internal use within Louisiana and also for connectivity between Louisiana and the rest of the nation and the world. This effort is of the utmost concern to all researchers in Louisiana, since the success or failure of this effort will go a long way towards determining our overall research climate in the coming decades.

Although Andrew Tannenbaum, a distinguished computer scientist at the Vrije Universiteit in Amsterdam, may have been the first to use the analogy between transportation and communications, he is certainly not the last. The major effort going on today in the United States government in terms of creating a high-performance national network is often referred to, by Vice-President Gore and others, as the creation of the electronic superhighway; and the importance to the nation of such a network is compared historically to the development of the interstate highway system in the 1950s.

The development of this new "interstate" will, however, have a more profound impact on research even than the I-system. A dominant characteristic of research in

the mid-20th century (because there was less of it) was the model of the lone scientist, buried in his (almost always his, not her) lab, emerging only after thirty years for the trip to Stockholm to collect a Nobel Prize.

More and more today, the philosophy of the lone wolf researcher is vanishing. The Bell Laboratories once had as a principal criterion in hiring researchers the evaluation by management of the researcher's ability to communicate; that the lone wolf researcher could go anywhere, and do the same work, and Bell could read it in the journals. The researcher who has the ability to find a collaborator with whom a synergy can be established is the person who has the greatest opportunity for the true breakthroughs in science.

The benefits from this approach to research results in having researchers collaborate not only from different specialties in a discipline, but from across disciplinary lines, and, indeed, from across university campuses, state lines, and national boundaries. It is not hard to see, as well, that the existence of high speed computer networks forging these links are also a critical component in linking academic researchers to industry so that the fruits of their research can be more easily translated into practice.

The nature of collaborative research will inevitably change over the next five years. As it is now, many of us in Louisiana have become very familiar with the utility of on-campus, national, and international networks to interchange information. There are many research user groups highly active on the Internet so that it is possible in many areas of research to get updated daily on current research developments or issues just by scanning one's electronic mailbox. But this mode of communication is only scratching the surface of what is now technologically available and what will surely be economically available in the very near future.

Let us back up, however, and discuss for a bit the status of computer networking today. The fundamental unit in communications is the bit rate, measured in bits per second, or bps. If you connect to a campus computing facility by a dial-up telephone line, the chances are that your effective rate is either 300 or 1200 bps. 1200 bps can be described as having a line of text sweep across your display in about half a second. Thus a full screen of text (say, 24 lines), will be transmitted in about 12 seconds.

Perhaps equally as familiar is the communications rate 9600 bps. With such a rate, an entire display screen can fill with characters in about a second.

Today's Ethernet local area networks (LANs) are capable of carrying information at the rate of 10 million bps (10 Megabits per second or Mbps). Although Ethernet networks are suitable for building-wide or even campus-wide networks, physical limitations prevent them from being used for networks that connect computers that may be many miles apart.

Now consider the difference between the current modes of usage of networks and what will soon become commonplace. We tend to think of the information that is carried over computer networks as being textual. We create an electronic mail message, or read an article online, or perhaps send or receive a paper or report. When information can be conveyed as textual, the savings from the computer memory or computer communications point of view is enormous. This full page of text is composed of 3461 characters, or 27,688 bits of information. Over a 9600 bps line, we could transmit this information in 2.9 seconds. But humans are not creatures that are limited to conveying information by typed sentences in a human language. Our senses are much richer than that. And consequently, for computer communications to approach human communications, we need to be able to convey visual images, in full color, sounds, and conceivably even smells and tactile information. The advantage of communicating only text is that the old saying, a picture is worth a thousand words, is literally true. The storage or transmission of a page of text might require 3461 bytes of memory. But the same size page, when treated as a graphical image, requires 1,000,000 bytes, and perhaps 32 Megabytes for a full-color representation of the image. Furthermore, the transmission of sound is similarly complex. One second of compact-disk quality sound requires 44 Megabytes, or 44 million bytes of information. Consequently, when we speak of high-performance networks today, the minimum transmission rates are standards known as T1 (1.544 Mbps) or T3 (44.376 Mbps).

The capability of transmitting information in these volumes is with us today. There are many centers that have the ability to transmit such high volumes of information over a local network. But, research needs in the future will demand that a scholar be capable of such information transmission across state lines, and national boundaries.

About two years ago, the LCCSE approached the Board of Regents with a proposal. In short, it was that the creation of a statewide computer network capable of transmission of such high volumes of information was not only desirable but es-

sential, and that the LCCSE would attempt to obtain the initial funding for such a network through the National Science Foundation.

In response to our the LCCSE and others, the Board of Regents created a task force to try to implement such a network. This group, the Louisiana Computing Higher Education Network, has now received an award for \$486,000 from the NSF to support the hardware costs of such a network, and the network should be in place in this calendar year.

LOUISIANA HIGHER EDUCATION EFFORTS IN AUTOMATED MANUFACTURING AND HIGH PERFORMANCE COMPUTING

Many of Louisiana's universities have been deeply involved in research and technology transfer areas that are critical to development of this infrastructure for automated manufacturing. A few examples follow:

The Center For Advanced Computer Studies, University Of Southwestern Louisiana

The primary mission of The Center for Advanced Computer Studies (CACS) is to conduct research and provide graduate level education in Computer Science and Computer Engineering. CACS is a separate academic unit at the University of Southwestern Louisiana comprised of 38 research faculty and staff, and 268 graduate students. Areas of specialization are Artificial Intelligent Systems (automated reasoning, neural computing, robotics computing, intelligent machines, visual and image computing), Computer Design and Architecture (design methodology and automation, fault-tolerant computing, networks, parallel and distributed computing, VLSI and hybrid devices), Database and Information systems (data security, data visualization, distributed databases, information retrieval, and object-oriented systems), Software Systems and Engineering (computer languages, design methodology and automation, logic programming, simulation, and theory of compiling), and Mathematical Aspects of Computing (computer arithmetic, cryptology and coding theory, and theory of computing).

In 1992, CACS produced 17 Ph.D graduates (PhDCS and PhDCE), and 57 MS graduates (MSCS and MSCE), its faculty were responsible for \$4.6M of external research funding 150 peer reviewed publications, and its faculty participated in leadership roles at the national and international level. Sources of external funding include: NSF, ONR EPSCoR, U.S. Army, U.S. Air Force, LEQSF, LaSER, Shell, NASA, and Energy. GACS was recently awarded a \$2.5M EPSCoR grant in Neural/Parallel Computing. The faculty of CACS are active within the State of Louisiana and CACS is a member organization of the Louisiana Consortium for Computer Science and Engineering.

University of New Orleans

The University of New Orleans has been a leader in the development of high-performance computing using massive parallel architectures. The principal laboratory facility for HP computing research is the New Orleans Advanced Computation Laboratory (NOACL), which in 1988 acquired the first massively parallel computing system in Louisiana. The perspective that UNO has taken on parallel computing is that the approach to software development for massively parallel computing is the key to increasing productivity in these environments, and the development of a cadre of parallel software specialists is essential to maximize the potential of these hardware systems. Since UNO's first research in parallel systems, the NOACL has broadened to a computing facility with over 150 networked systems, an advanced VLSI testing environment, and the pending acquisition of another massively parallel system, possibly a Thinking Machines Corporation CM-5. The NOACL in 1992 exceeded \$1M in research funding for the first time. This center will also provide high-performance computing support for the new Center for Energy Resources Management being built at the UNO Research Park.

Louisiana State University

The LSU computer science department's faculty includes internationally known experts in several areas of computer science. This includes the following well-known lab:

1. *Robotics Research Lab.* This lab was started in 1985 to support a teaching and research program specializing in designing intelligent machines. More specifically, the lab has conducted important work on the problems of intelligent robot navigation, integration of knowledge in distributed systems, real-time expert system, parallel control algorithms, etc.

Many of these projects have involved collaboration with NASA, ORNL, NAVY ONR, JPL/Cal. Tech.

2. *Software Engineering Lab.* The research conducted in the lab is devoted to the development of methodologies, techniques, and tools that are capable of dealing with complex applications that are now required of software technology. Current emphasis is on research in object-oriented software development, including informal specification techniques, formal specification/design languages, software validation and software reusability.

3. *Concurrent Computing Laboratory.* It is an interdisciplinary lab. involved in research and education in computational science. The research program includes molecular dynamics simulation of ceramics, clusters, zeolites, computational nanoelectronics combinatorial optimization and also implementation of simulation algorithms on highly parallel architectures.

4. *Center for Advanced Microelectronic Devices.* CAMD is a center designed to carry out research in semiconductor lithography in the search for new microelectronic devices.

Tulane University

Tulane University has active research in high performance computing, particularly in the use of genetic algorithms in massively parallel computation. The goal of the research is classic cloud species and subspecies by processing satellite radio meter data. Changes in cloud cover percentage and cloud types are directly related to climate changes so the long-range goal is to automate these analyses. The algorithmic paradigm being employed, genetic algorithms, is based on the mechanics of biological evolution. Pairs from a set of candidate solutions are recombined giving a new solution that, in general, is a better one than either of the originals. The algorithm is uniquely amenable to parallel computation and a testbed using a supercomputer at the Goddard Space Flight Center is being built.

Louisiana Tech

Louisiana Tech also has the Louisiana Tech Manufacturing Systems Engineering Research Center. This center was established in 1988, and its objectives are to encourage and coordinate coherent inter-disciplinary research in manufacturing systems engineering, to provide a recognizable entity through which manufacturing industries may obtain assistance, and to provide a focal point for developing sponsorship for the integrated instruction/research program in manufacturing systems engineering.

Southern University

One strong direction of research at Southern University is in the area of expert Systems. There is ongoing research into neural networks, specifically pattern classification. Other examples of research at SU involve research in computer graphics, which one faculty member initiated while working in the Personal Software Division of Hewlett Packard Corporation. Another faculty member is conducting research in numerical linear algebra software. Other SU computer science professors have extensive experience in computer modelling and simulation of electromechanical systems. Currently, some SU professors are conducting research which requires modelling and simulation of economics experiments. One very important project being conducted by this Department and supported by a research grant from the NASA/Goddard Center is to conduct research necessary to combine the Systems Improved Numerical Differencing Analyzer (SINDA), "a software system [for] * * * solving lumped together parameter representations of physical problems governed by diffusion-type equations," with other versions. SINDA has a predecessor as well as offsprings, each version offering varying degrees of capability to the user, e.g. SINDA and SINDA '85/FLUINT. These versions have been generated by Chrysler, the Johnson Space Center, NASA/Goddard, and Martin-Marietta. In addition, SU researchers will create an engineer-friendly interface to the system and port the system to personal computers.

Northeast Louisiana University

The research component in the computer science department has been strengthened by hiring faculty with Ph.D. degrees in computer science involved in active research and by creating an environment for existing difficulty to conduct research. A number of research projects are funded by NSF, LEQSF, 3M Corporation, and U.S. Waterways Experiment Station. The faculty collaborate with researchers at other Universities and research laboratories. NLU has also played a key leadership role in the development of the statewide high-speed network.

STATEWIDE VLSI DESIGN AND TESTING FACILITIES

There is an unusual amount of research and education in VLSI design, which is and will continue to be a critical supportive area to intelligent machine development. A recent and innovative project funded by the LaSER program will extend the VLSI design and testing facilities at USL and UNO statewide, and provide opportunities for college faculty and students statewide to avail themselves of training and lab work in the use of these facilities.

BRINGING THE NATIONAL RESEARCH AND EDUCATION NETWORK TO ELEMENTARY AND SECONDARY EDUCATION

From the perspective of a computer network designer, the problem of building a national computer network for all elementary and secondary school students and teachers presents a unique challenge. There is a physical characteristic of school districts that makes them unlike almost any other organization in society. As an example, consider a school district with, say, one thousand teachers and 20,000 students. The teachers are probably spread out over, say 40 school buildings, which might themselves be spread over a distance of ten to twenty miles.

Any other organization with one thousand employees is likely to have them concentrated in one or two buildings. The United States Senate probably has several thousand employees, and yet they are all capable of being housed in about 3½ buildings, all adjacent to one another. Thus the challenge of designing a network for the particular configuration of elementary and secondary education is indeed enormous.

Another factor that presents an enormous barrier to K-12 networking is the current state of communications in elementary and secondary schools. In what other sector of the economy do we pay professionals upwards of \$30,000 and yet not give them their own telephone?

One emerging technology which will prove to be of considerable benefit in the development of K-12 networking will be the development of "wireless modems." Existing relatively low-cost devices can carry network traffic at relatively high speeds, using microwave communications, at line-of-sight distances (say, up to 30 miles); and these devices may solve a number of problems in terms of developing high-speed network links for elementary and secondary schools. An experiment is taking place currently at the University of New Orleans in integrating such devices, and elementary and secondary schools, into Internet communications.

BENEFITS TO LOUISIANA OF SENATE BILL 4

We believe, from what we have described above, that Louisiana has undertaken most of the developmental work necessary for advances in the automation of manufacturing technology and the development of "intelligent machines." The manufacturing sector in Louisiana has a characteristic that it has many companies that are small- to medium-sized, and for that reason, among others, adoption of new manufacturing technologies has not been as rapid as one might envision.

However, through the cooperative efforts of the United States, the State of Louisiana, and the institutions of higher education in Louisiana as represented by those cited above, we feel that the climate is now ripe for the development of our own statewide manufacturing center. The passage of S. 4, and the subsequent expansion of the Advanced Manufacturing Technology Development Program, will, we hope, provide an opportunity for Louisiana to develop in this regard.

Since the introduction of S. 4, we have seen in the Louisiana research community a rededication of effort in developing a comprehensive proposal for the creation of a new State Manufacturing Center.

FINAL COMMENTS

In our endorsement of the overall objectives of this legislation, we do not want to conclude without addressing some issues which, we feel, still need to be addressed in the deliberations on this bill.

As we examine the level of authorization in this bill, it becomes clear that an immediate impact will be to change the relationship of the research community in the United States to the national government.

For many years, the National Science Foundation has been the agency of the federal government which has provided the greatest direction to research, at least in non-medical areas. However, the passage of S. 4 and corresponding appropriations would make the Department of Commerce and the National Institute of Standards and Technology as important in the formulation of national research goals as the NSF. A concern that has arisen in the research community is whether the objective

of the United States government is to diminish our effort in basic research, in return for the considerable expansion in applied, or industrially-based research, through NIST and Commerce.

The fears of the research community were not allayed by the deliberations of the NSF Futures Commission, which seemed to signal to many researchers that the future for NSF was indeed to be in support of applied research.

In our view, S. 4 comes at a very propitious juncture. It would stimulate an entirely new community of researchers, and can achieve its objectives of national competitiveness. It is not necessary, however, that the research areas stimulated by this legislation serve to diminish national efforts in basic research. It is also of the utmost importance that this effort continue. Thus we would hope that adoption of the National Competitiveness Act of 1993, and later appropriations in support of it, will not occur at the expense of the support of basic research through the National Science Foundation or elsewhere.

CONCLUSION

In conclusion, we would like to thank the Honorable Members of the Committee on Commerce, Science, and Transportation for affording us the opportunity to present you with this testimony. We wish you our best in your weighty deliberations on this and other issues, and we are confident that the fruits of your efforts will benefit not only Louisiana, but the nation, and indeed the world as a whole, as the United States regains its position of leadership in world manufacturing.

The CHAIRMAN. Very good, Dr. Kilcrease. A very important member, John Breaux from Louisiana wanted to be here and present you and hear your testimony, but he is presently on the floor with an amendment of his own and he apologizes for not being able to make it, and I am sure you understand.

Dr. Myhrvold.

STATEMENT OF DR. NATHAN P. MYHRVOLD, VICE PRESIDENT, ADVANCED TECHNOLOGY AND BUSINESS DEVELOPMENT, MICROSOFT CORP.

Dr. MYHRVOLD. Like many of the people here, I am happy to support S. 4. My interest is primarily in title VI and the issue of the national information infrastructure. The news I would like to bring is that I think Title VI of S. 4 may be even better than we think because the seeds that it sows in creating a national information infrastructure provide an unprecedented opportunity for American business. An opportunity to create new markets, new products, to take back industries such as consumer electronics that have been lost to foreign competition, and to create the industrial base which is going to be critical for the next several decades.

Much of the discussion of the information infrastructure has been tied to the switches or the phone lines or the cables. If you compare this to electrical power, it would be like talking about high-tension lines, and the transformers, and the generators. Now, that is a very critical part. You cannot get electrical power without those power lines. But that is not the exciting thing about electricity. It is all of the electrical appliances we plug in at home. It is the electrical equipment in business. That is the real issue.

So, although it is very important for us to focus on building that national information network, building those power lines and distribution channels, we also have to think about the markets that are created by what plugs into it.

Now, that is an issue that is not going to happen by itself. It would be possible to create national networks, and yet fail to capitalize on the advantages of the intelligent machines and software that plug in and give people its real value.

Thus, there are some critical factors that we are going to have to watch for do we go forward in formulating national policy in this area.

These networks have to be open. That means that entrepreneurs who have a better idea, whether it is a better idea for a smart telephone or a smart TV, or a better idea for software to use it, that they have to have access to those networks. They have to be able to get their products out there. It is a very critical point.

A second issue is compatibility. You have got to be able to create information, to create products, and have a reasonable degree of certainty that they are going to work in Louisiana, in South Carolina, across the entire country.

Now, that is not just a question of connecting the things electrically. I can use a phone line to talk to someone anywhere in the world, but if he and I do not speak a common language, we are not going to communicate even though the phone line gets me there. The computer systems that we tie into this network have to be designed with this compatibility in mind.

Finally, as we go forward, we have got to really think about what ways policy can provide leadership to the people creating software and some of these new smart devices.

To make this notion of smart devices more concrete, let me use the analogy of television. A color TV in 1954 is essentially the same as color TV today. If you turned one on it would receive the same signals; if you sent today's TV set back in time, it would work. It is a static industry because that was the nature of technology at that time.

I do not think I have to tell you the computer from 1954 does not look much like we have today. In fact, the computer industry is one where even 18 months is an eternity. We are on a constant technology treadmill.

Now it happens that our Nation is unique among the world in having the depth of intellectual support necessary to stay on that treadmill and to succeed. American companies lead the world in personal computers.

For many years, people suggested maybe the Japanese were going to take over that market. An interesting thing is happening in Japan right now—there is a price war. A price war caused by a couple of American companies, including Compaq, Dell, and several others, who have imported lower cost, more functional, better quality machines to Japan at a lower price. They do not own the market yet, but they have caused the Japanese companies to cut price and scramble, a scene that we have seen happen here all too often.

Now, our interest is in making sure that we retain that lead and we use it to take back some of these industries. As these new intelligent devices we plug into the network rely more and more on computing, they will draw more upon those strengths and allow America a unique opportunity to create the machines for the 21st century. If we do not, however, somebody will, and we will see yet another example of American technology going only to bootstrap somebody else's industry.

So far our lead is very strong. What we need at this stage is national leadership in order to really pull these elements together.

Not at the level of deciding all of the bits and bytes of little technical specifications, but rather to set our sights, to set the goals, and help each of these industry groups. Whether it is the phone companies or the computer industry or the cable TV people, help us set our sights higher than the constraints we might otherwise set for ourselves.

That is all. Thank you, sir.

[The prepared statement of Dr. Myhrvold follows:]

PREPARED STATEMENT OF NATHAN P. MYHRVOLD

Mr. Chairman, Members of the Subcommittee, my name is Nathan Myhrvold. I am Vice President of Advanced Technology and Business Development for the Microsoft Corporation.

Microsoft develops, markets and supports a wide range of systems and applications software for personal computers or "PC's". By making it easier to use personal computers for an increasing number of purposes, Microsoft products have contributed to the "PC revolution" during the last 15 years. The growth of our company has paralleled the increase in the number of people who use personal computers in this country, from one million in 1980 to more than 90 million today.

We greatly appreciate the opportunity to testify in support of Title VI of S. 4, the information infrastructure provisions of the bill, and to point out more generally the important opportunities presented to America by the digital information future. Title VI of S. 4—The Information Infrastructure and Technology Act of 1993—will accelerate the arrival of the digital information future by expanding federal support for research and development on applications of high-performance computing and high-speed networks for education, health care, manufacturing, and digital libraries.

SUMMARY

The digital information revolution is underway. New technologies make it easier to transform analog messages, including the spoken word, text or pictures, into the digital language of computers which then can be transmitted, processed and stored electronically. In digital electronic form, textual audio and video information can be combined, used by a variety of different machines in new and exciting applications, and transmitted between different machines.

The United States needs an advanced information infrastructure that will accommodate and facilitate the widespread use of digital information. It would be difficult to overstate the importance of this undertaking. In 25 years we will look back and ask how we ever got along when information was in analog form. In 25 years, the American economy will be as dependent on the information infrastructure we develop today for its economic well-being as it is on the electrical and transportation infrastructures we put in place during the last two generations.

America's information infrastructure must include high capacity interoperable networks capable of moving tremendous amounts of information practically instantaneously. Thus we commend the vision of Vice president Gore and this Committee in enacting the High Performance Computing Program. But it is essential to understand that information infrastructure is more than bust wires and switches. What makes the network valuable are the information machines that will process the information in useful applications and the software that will make the entire system work.

The digital information infrastructure thus conceived offers two tremendous benefits for America.

First, as this Committee has recognized with this bill, new and innovative applications of digital information will offer American businesses and consumers—wherever located—benefits in such areas as education, health care, and manufacturing.

Second, and as least as importantly but to date unappreciated, American manufacturers will have the opportunity to take back manufacturing of consumer electronics and other sophisticated machinery from the Japanese, reclaiming highly skilled, highly paid jobs in the process.

But to realize these benefits, our digital information infrastructure must have two essential characteristics.

First, you must be able to use the same information in a variety of machines and to transmit the information between different types and sizes of machines everywhere. In short, there must be interconnectivity and interoperability.

Second, we must have interactive, "smart," information machines that can receive, process and transmit information. In short, you need consumer computers, not the

limited purpose, passive, "dumb," consumer electronics prevalent today. This fundamental change is what gives American industry the opportunity to leverage its lead in computer systems design and computer software to take back manufacturing from the Japanese and others. Moreover, the nation that develops the skills and expertise in manufacturing these consumer computers also will be the leader in manufacturing a whole range of sophisticated machines—all of which will tie into the information infrastructure at some level.

In all of this, the challenge for government officials is to promote the development and deployment of such a digital information infrastructure without accidentally "freezing" technology at yesterday's levels.

BACKGROUND: THE MICROSOFT CORPORATION

Microsoft is driven by the vision of "information at your fingertips." The idea is that all the data needed in business, school or at home should be instantly accessible from a personal computer. That means making software programs that are simple enough to use, yet powerful enough to deliver the desired information.

Microsoft's products include system software, such as MS-DOS and Microsoft Windows, that act as a computer's "nerve center" allocating computer memory, scheduling the execution of basic functions, and controlling the flow of information among the various components of the microcomputer. We also develop and market application software such as Microsoft Word and Microsoft Excel, our word processing and spreadsheet programs.

Microsoft is a leader in the global personal computer software market. Last year, more than 55 percent of Microsoft's almost \$3 billion in revenue came from foreign sales. Indeed, the international division is one of the fastest growing parts of the company. Microsoft markets more than 100 products in over 25 languages and has subsidiaries in 39 countries around the world. Our R&D expenditures are significantly more than the average for all American businesses. We employ about 10,000 people in the United States (including over 3,000 programmers and other technical employees) and another 3,000 overseas.

THE NATIONAL INFORMATION INFRASTRUCTURE OF THE FUTURE IS MORE THAN JUST WIRES AND SWITCHES

To date, when people have talked about a national information infrastructure, most of the discussion has focused on the transmission medium. Most often mentioned is a fiber optic, high speed, "data highway" that will be able to send much greater amounts of information, much faster, than copper telephone wires or coaxial cable (used for cable TV). More recently, attention has been paid to over the air transmission possibilities, such as direct broadcast satellites, high definition television, and personal communications services that would enable individuals to be tied into the network wherever they are.

All of this is incredibly important. But it seriously shortchanges the importance of an information infrastructure.

Let me give you two analogies. First, our transportation infrastructure is not just the concrete and steel making up highways, bridges, railroads and airports. It is also the trucks, trains and planes. There also are the parking lots, stations, terminals, filling stations, restaurants and hotels. There are also state highway departments that maintain the roads, toll authorities that charge for the use and police departments that make sure everyone follows the rules of the road. Another example: electricity. At one level are the powerplants, the transmission lines, the transformers, and outlets in the home. But the exciting thing isn't about the electricity itself, it is the appliances we plug into it and the things they enable us to do. Then you need to consider all the businesses and homes which use those appliances to do things, the companies that produce the appliances, and the businesses that support them.

When we consider tomorrow's information infrastructure in this light we can begin to realize just how important it is. It would almost be silly—if it were not so important—to even ask how much of the U.S. economy depends on electricity or transportation. You could hardly do anything without it. And twenty five years from now, the same will be true when we talk about the national information infrastructure!

Thus, what makes the digital information infrastructure so exciting is not just a lot of fiber optic cable in the ground or low-level satellites in the air. It is not even the fact that information is being produced and maintained increasingly in digital form. What makes all this interesting and important are the machines that plug into the network to do useful (and innovative) things. Today, personal computers, automated teller machines, compact disc players, bar code scanners, fax machines

and voice mail systems at the office are all digital. Kodak now has a system for the home photographer that will digitize your photographs on 35mm film enabling you to view them on your television. Soon we will witness the introduction of digital cellular phones and television (HDTV).

Finally, it is essential to understand that what makes this whole digital information system work is software. Fiber optic networks and digital information machines without software are just wires and boxes—they would be incapable of responding to even the simplest command or forwarding the simplest message. The hardware may be the "muscle" but it is software that is the "brains". Software transforms the raw power of high capacity networks and computers into information systems that help people at work and at home.

In a very broad sense, software does this in two ways.

First, as all information becomes digitized, software helps the user navigate oceans of information to locate or create that which is useful or desired. Software programs will locate and identify information from a variety of databases in response to users' requests.

This experience will have to be applied more broadly. If you go into a library, you will find that it has been very carefully designed over the years to put certain material on certain shelves with card catalogues enabling you to locate them based on various search strategies. But there is no equivalent for on-line information services. There is no equivalent for television. But there will be. Consider that rather than consulting a written TV guide, you will simply be able to touch your TV screen and work through a series of interactive commands. Interestingly, you can even have software learn about your preferences and help you select in the future. Thus, if you like to watch John Wayne movies and have seemed to watch many of them recently, your television system may let you know when a new one is going to be on.

Second, once a decision is made to send or receive information, it is the software that will actually "pull" the information through the computer's switches and wires that are the physical network. Today, we think about voice moving through telephone wires and video through cable TV and the broadcast television system. But in the future, all the information will be digital—data that has been incredibly manipulated by software. Software will be the key to making the information infrastructure as ubiquitous and unnoticeable as our water supply, plumbing, electricity, or the telephone.

More generally, it is safe to say that as computer and communications technologies become more powerful and less expensive, we will expect them to do more for us and software is the key to making it all happen: always easily and often invisibly.

BENEFITS FOR AMERICAN USERS OF DIGITAL INFORMATION

The digital information age will enable everyone to be "plugged in" to everyone else. People anywhere in the country—and, indeed, around the globe—can access, store and process the same information. Thus, tomorrow's information infrastructure will allow people to break the tyranny of geography and location. This is enormously exciting because to date advanced technology and information has only been accessible to very small numbers of people in universities and advanced industries. But in the future, it can be harnessed by nearly everyone.

Moreover, when in digital form, textual, audio and video messages can be combined, allowing information to be integrated in a way that makes multimedia applications possible.

The results of all this are new and innovative applications.

Consider: today, if you can physically get to the Library of Congress, you can get an unparalleled amount of information. In large metropolitan areas we also have great libraries. But we don't have great libraries in rural areas. Yet with the coming information infrastructure, we can make access to great libraries just as available in rural areas.

Another example: Rising health care costs are a crucial problem facing this country. Certainly the United States is the world's leader in developing advanced health care technology. But these wonderful machines are also quite expensive. If we can tie these together in a network, then we can share them more efficiently. Rather than having what amounts to a super computer built into each CAT scanner, instead you could have much cheaper machines send the information to a remote super computer—or to a remote specialist for that matter—where it could be analyzed and a diagnosis returned. Another major aspect of health care costs is simply the huge amount of record keeping—patient histories, test results, payment information. Electronic processing, consolidation, storage, and transmission of all this information promises tremendous savings.

Entertainment is another exciting area. As long as you have a broadcast system where you have a relatively small number of channels—and even cable television has a limited number of channels—a programmer is required to meet the needs of a certain size audience in order to justify taking the space. But the new digital networks will allow us to put literally tens of thousands of different movies, televisions, documentaries, and multimedia information that combine text with graphics all on-line and viewable at one's convenience.

Of course, it often is asked who will pay for these tailored services? The implication is that individuals will not wish to do so. Well I believe that some will. I also think it is mostly besides the point because advertisers will be delighted to reach such targeted audiences and are likely to be willing to pay a premium for doing so. Thus, it may well be that a viewer will have the choice of either paying directly for a service or accepting a stream of advertisements and letting the advertisers pay for the programming.

Obviously, there are many other things that the new information age will enable us to do, many of which we still have yet to think of. These include allowing people to work at home, avoiding travel costs, reducing pollution, energy consumption, and congestion in our inner cities. Thus people might "work" in New York but be able to enjoy living in Charleston.

It is important to understand, however, that in order to fully realize the potential benefits of the digital information future it is necessary that the same information in fact be able to be used in a variety of machines and that the information be able to be transmitted between machines.

For example, to improve our productivity and effectiveness at work we need to be able to integrate information received by electronic mail, voice mail, faxes, video mail (coming soon) and electronic documents. Similarly, there is no reason that everyone can't have what amounts to an automated teller machine in their pocket. With a small, checkbook-sized device, one could balance the bank account, manage finances, and pay bills at any point, at any time, anywhere.

But we can not assume that the information appliances of the future will in fact develop this way. Today, most of our information machines such as telephones, televisions, fax machines, etc. are all more or less passive, limited purpose, "dumb" machines which don't do much information processing.

We have found that you can add to these machines' functions a little bit—such as when you buy a VCR for your television or buy an answering machine for your phone. This helps store information and add some additional functionality. But you have to add a whole bunch of equipment—and it's difficult and expensive to do.

To fully realize the potential of a digital information future, you need interactive, smart machines that can receive, process and transmit information. You don't need consumer gadgets—instead you need consumer computers.

The difference between your telephone and an answering machine would be just the piece of software that stores the information for you. On a personal computer, the difference between a word processor, a spread sheet program, a data base or a game is merely different software. Changing the features, or even the utility of the consumer information device, can be done simply by changing software. Not only does it allow us to benefit from the myriad applications that will be developed to use all the information available, but it also gives America the chance to take back manufacturing of consumer appliances.

BENEFITS FOR AMERICAN MANUFACTURERS OF INFORMATION MACHINES

If we need smart, interactive, consumer computers to fully realize the possibilities of the future information infrastructure, this need in fact gives America the opportunity to take back the lead in manufacturing those devices.

Time and time again American creativity, ingenuity and entrepreneurship have developed new consumer electronics: copy machines, fax machines, the VCR all were invented here. As members of this Committee know well, the Japanese (and other countries) have been extraordinarily successful in mass producing these relatively "dumb" consumer electronics. They have made incremental improvements, lowered costs, and miniaturized. Yet fundamentally, the equipment is essentially assembling components.

Indeed, the same holds true in the semi-conductor industry. Americans have largely been responsible for the design and architecture of chips. But the Japanese have been successful at manufacturing based on existing designs and then making incremental improvements. For example, they make a memory chip that has slightly more memory.

But the U.S. continues to lead the world in computer system design and architecture and the software that goes into them. These are American technologies driven

by companies in the United States who have shown a continuing ability to keep the pace of innovation up.

In these industries, incremental designs are insufficient. Technology moves too fast. Instead, you must make revolutionary changes and do so on a regular basis. The frequency with which these changes must come about has been such that few outside the United States are able to keep from falling off this fast moving technology treadmill.

The personal computer itself is exactly one of these examples. American companies innovated the hardware and software and despite predictions that foreign manufacturers would overwhelm the U.S. PC industry, it simply has not occurred. In fact, right now U.S. manufacturers such as Dell and Compaq actually have started a price war over computers sold in Japan. They have not only become very effective in selling their machines there but they are actually changing the nature of that industry.

So we actually have a major opportunity to leverage our lead in computer hardware and software to take back the consumer electronics industry from the Japanese (and other producers). If that happens, we are also going to take back lots of high paying interesting jobs. Precisely the types of jobs we need for America's future.

This point deserves to be emphasized. Whoever figures out first the techniques of how to manufacture these smart appliances will be the leader for many years to come in manufacturing a whole range of complicated machines. Industrial air conditioners, trains, machine tools all will be heavily computerized and all will plug in at some level to the digital information network. (The only devices that will not be "smart" will be entry level "commodity" type items.) Thus, the nation that develops the skills and expertise in such manufacturing will command a powerful position as we enter the next century. Remember: someone will learn how to manufacture these devices—if we don't our foreign competitors will.

CONCLUSION: A VISION FOR AMERICA'S INFORMATION INFRASTRUCTURE

In order to fully realize the potential of the digital information future—both for users of the information and manufacturers of the consumer computers hardware and software—the United States needs an open digital network with two characteristics.

First, there must be interconnectivity and interoperability. We must ensure that the same information can be sent to and from different types and sizes of machines everywhere. This is essentially the same type of problem that exists today when trying to connect different types of computers running with different software in local and wide area networks; only in the future the problem will assume much greater dimensions because there will so many more machines trying to communicate with each other.

But how do you ensure such interconnectivity and interoperability? Frankly, we are hesitant to suggest a top down government imposed standard. We think it is simply antithetical to the fast moving technology treadmill with rapid technological innovations. Instead, we believe the way solutions to the connectivity problem have developed to date is instructive. Essentially the government got things going and American industry took off from there. Let me explain.

Today there are an estimated 5 million people worldwide connected through several thousand interlocking networks in a large electronic web called the Internet. Indeed, some analysts believe the Internet traffic rate is growing at rates as high as 15 percent per month. As you know, our federal government created the backbone of this network by financing the construction of links between universities, research laboratories, and military installations. But increasingly businesses and individuals are using the system to communicate and provide information services. Importantly, it is the private sector that has been able to keep up with technological developments and establish protocols and procedures for linking disparate networks into a larger whole.

We think something similar should occur with respect to the development of the next generation of data networks. For that reason, we are pleased that S. 4 authorizes federal funding to develop new technologies. The High Performance Computing and Communications Program, which this Committee played a lead role in enacting, is an important first step toward the digital information future. Title VI of S. 4 will extend the technology advancements made in the HPCC Program to important applications that will benefit many Americans. The demonstration projects authorized by S. 4 in education, health care, manufacturing, and digital libraries will provide a forum for the government and the private sector to work together to develop new applications—which really are a combination of computer hardware and software.

Given the great uncertainty regarding the way in which many of these technologies will develop we think it is wise to seed many test beds; certainly we at Microsoft are betting on many different horses.

We also think there is an appropriate regulatory role for government in encouraging the deployment of technology. Yet from a technologist's perspective, I simply caution that it will require extraordinary vision and leadership by government to promote technology but at the same time not accidentally get in the way by freezing technology at yesterday's levels.

The dilemma is illustrated by the question of deploying ISDN—the Integrated Services Digital Network. ISDN enables the telephone network, which was built for traditional analog voice calls, to carry far more information at higher speeds. As a result, ISDN enables the development of many new applications in education, health care, telecommuting, video-conferencing, etc. Moreover, it can be done soon and at relatively low cost. Thus, we believe it should be encouraged and is a significant step towards the digital information future. Yet at the same time, it is only an interim development: the capabilities of ISDN pale besides a truly high speed fiber optic network. So we would be extremely hesitant to support any government action that precluded the development of fiber while promoting ISDN.

Second, we must have interactive, "smart," information machines that have computing "built into their woodwork." These will come in a variety of shapes and sizes and perform very different functions. Some will be larger than today's desktop computer. They will have displays geared towards viewing in a living room or for multiple viewing in a conference setting. Others will be smaller than today's desktop computer. They will range from relatively simple computers embedded in small appliances, to battery powered machines that will live in a pocket, to electronic notebooks.

I think it is useful to keep in mind two basic models.

The living room machine will get a lot of attention because assuming a fiber optic network, large (high definition) screen, and the ability to do graphics and video processing, such a machine would replace the television and all that entails. I call this the "Video PC."

The pocket computer—and it will be a real computer, not just a limited purpose scheduler or whatever—is very interesting because it will be an individual's mobile connection to the information network. The general purpose nature of this machine would allow people to combine applications such as messaging, keeping organized, taking notes, finding where you are and how to get to where you want to go, financial transactions, etc. It could replace hard copy documents of identification and authentication, memberships, cash, checks, credit cards, receipts, keys, tickets and schedules. For these reasons, I call this type of machine a "Wallet PC."

If America succeeds in promoting a digital information infrastructure with these fundamental features than I have little doubt that:

- As users of information, American industry will innovate in the development and deployment of productive applications. Quite simply, it will not be possible to have an effective, efficient business ten years from now without being involved in all this.

- As manufacturers of information machines, Americans will reclaim highly skilled, highly paid jobs, by leveraging their lead in computer system designs and software. Those who learn this new industry early, invest in it, and champion its cause, are the ones who are going to be the big winners. And if it is not us, be assured that it will be others abroad who will do so.

Thank you.

The CHAIRMAN. Thank you very much.

Dr. Lucky.

STATEMENT OF ROBERT W. LUCKY, Ph.D., VICE PRESIDENT OF APPLIED RESEARCH, BELLCORE

Dr. LUCKY. Yes, thank you, Mr. Chairman. My name is Bob Lucky. I am vice president of Bellcore, which is the research arm of the seven regional Bell operating companies created at divestiture in 1984.

I have been asked to comment on title VI, which is the information infrastructure and technology part of the bill, but I did take the trouble to read and study the entire bill, and I was surprised

that I could not find anything to disagree with in the bill. In fact, I would say that the bill is inspirational. Inspirational on a personal level, inspirational to my industry, the telecommunications industry, and ultimately to the American people. So, I would commend you, Senator Hollings, and your staff, for an eloquent piece of legislation whose aims we support fully.

Now my written testimony describes some of the developments in the regional Bell operating companies that pertain to the national information infrastructure—the building of switched broadband networks, and of promulgating applications for these networks.

However, in my comments at this time I would like to concentrate on a matter of deep concern to my industry, one which was already foreshadowed, Senator Hollings, by your conversation with Senator Kerrey, and that is the role of Government and industry in building and maintaining this infrastructure.

Now, I think that this bill is insightful in focusing on the applications—improving education, building digital libraries, improving the provision of health care, increasing productivity of the Nation's workers—and we support these aims fully. And I think that the idea of going out to the users and building the applications is the right direction to go, and we feel this is a beneficial role of Government and we can see other beneficial roles that Government can play.

For example, you can provide funds to schools, libraries, health-care providers, and research institutions for the training and for the use of these networks. And then there are a number of roles that Government can play in promoting cooperation.

We have an industry, the telecommunications industry, that is characterized by—on the one hand by bitter competition and on the other hand by a need for cooperation. And in many cases we have no cooperating agent, no catalyst to promote that cooperation, and that is where Government can really be very helpful.

You can encourage collaboration among Government, industry, academia, and user groups. You can promulgate standards and conformance testing. You can promote interconnectivity and you can develop policies and resolve issues around network integrity, security, privacy, and intellectual property. Those are all very good things that Government can do to help us.

And I am adding one more, which is a surprising one to me, and that is that you can give us vision. And you have done that, and I thank you for it. It is an uplifting thing that Government can do, and this goes back quite a ways and the administration has taken this up and it really is a wonderful vision that has been given to us.

However, we feel that Government should not build or operate production networks. Now, production networks are those networks that carry traffic that might be carried by competing commercial facilities. Or they should not subsidize general usage of these networks. And this goes to the heart of our concern, the specter of a network built and operated by Government and missing all the potential contributions that could be made by private industry.

I think this bill is a chance, and a chance that is fast disappearing, to clarify and to give guidance on the roles of Government and industry in this information infrastructure. Yesterday in a meeting,

someone described this issue of the relative roles as a visceral issue. And I think it is very difficult to convey a visceral issue in this austere setting today, but let me speak personally for a few minutes about my ambivalence, my schizophrenia about Internet, because it has already been discussed here today.

I like to make music and at night I go up to my attic where I have a computer room and a music synthesizer, and through my computer I reach out into Internet and I pluck programs from the ether from far away computers in Canada and California and Europe, programs for music creation. And it is a wonderful thing and it is free.

My friends are amazed that I am able to do this, and I tell them, well I have got access and I know how to do it. And this bill actually wants to do that for everybody, give them access and teach them how to do it, so they can do things like this and create their own music, as it were, whatever that music might be.

But back to my schizophrenia. The next morning I put my suit on and go to work as a professional in the telecommunications industry, where I have no incentive, no motivation to build facilities, to build networks that provide services like Internet. And I have not had that for the last decade because Internet has preempted all this. How can I compete against a free service? Why should I?

So, that is the schizophrenia we have and the specter of Government-provided telecommunications services. Now is the time to provide guidance and to get the incentives right, to spell out the roles of Government and industry.

Now, we believe that this language could be put in this bill and we have a suggestion, and it has already been mentioned today, and that is the policy statement put out by the CEO's of the telecommunications industry. It was just recently put out. It has been attached to my testimony and was mentioned earlier today. It has been signed by the CEO's of the seven regional Bell operating companies, but not only by them, by AT&T, Sprint, MCI, GTE, Cincinnati Bell, Southern New England Telephone. Frankly, I am in awe that all these people signed anything, and so I think it is very significant.

Now, this policy statement gives a framework for establishing this relationship of Government and industry, and I just want to mention the key cornerstone of this framework, and that is to separate out experimental networks like the gigabit networks, like the gigabit test beds, and production networks that handle traffic that could be handled by commercial services.

In the experimental networks we feel that Government and industry can cooperate to provide services. In the production networks, we feel that this should be done by industry. And so I think that this policy statement, which is much more comprehensive than the short cornerstone that I could give today, provides a framework for this differentiation of the roles.

So, in summary, I believe the bill is inspirational. We totally support its objectives, but we do have a concern with the roles of industry and Government. We believe that this bill is a chance to clarify these roles and we have a suggestion as to how this might be done.

Thank you, Mr. Chairman.

[The prepared statement of Dr. Lucky follows:]

PREPARED STATEMENT OF DR. ROBERT W. LUCKY

Thank you for the opportunity to testify before this committee. My name is Robert Lucky and I am vice president of applied research at Bell Communications Research (Bellcore), a research consortium created at divestiture in 1984, and owned by the seven regional Bell operating companies (RBOC's). My organization, applied research, develops new technologies that can be used to advance the telecommunications infrastructure. As researchers on the cutting edge of technological development, we have much to contribute to the national effort to build a national information infrastructure. I am here today to present a researcher's perspective on the issues raised by S. 4, the National Competitiveness Act of 1993, specifically focusing on title VI at the request of the committee.

We strongly support the broad initiatives outlined in title VI of S. 4, entitled "Information Infrastructure and Technology." There now appears to be wide acceptance of the proposition that a national information infrastructure is a critical ingredient in America's ongoing effort to build on her current strengths and secure her future. Nevertheless, there appear to be several overlapping, and sometimes contradictory, visions of what a national information infrastructure should be. Hearings such as this one can clarify issues and allow potential participants in this initiative to understand how best to contribute to the national effort. It is my hope that my remarks will be part of this process of clarification.

It is critical that we develop a common vision now of what the national information infrastructure should be in 3 to 5 years. This vision should be developed jointly by Government, industry, and key user communities. The transition steps necessary to move from today's electronic networks to the vision of a national information infrastructure need to be defined. These steps involve both technological and policy transitions.

My testimony today will cover six topics: (1) a brief review of the regional Bell operating companies' communications networks and their capabilities, both present and future; (2) key issues relevant to the development of a national information infrastructure; (3) key industry and stakeholder activities aimed at developing both a national information infrastructure vision and transition steps to achieve such a vision; (4) some desirable characteristics of a national information infrastructure; (5) a framework for a national information infrastructure; and (6) specific recommendations for S. 4, Title VI.

I. THE REGIONAL BELL OPERATING COMPANIES' NETWORKS

Until recent years, the RBOC's offered a host of traditional wireline services and facilities primarily in support of voice communication. Other services are offered by related industries. Cable and broadcast television companies offer video programming. Radio frequency has been used for broadcast programming and cellular phone service. Computers and computer communications systems are used for data transfer. In the past, these industries used very different technologies. As a result of recent advances in microprocessors and fiber optic design, the technologies of the telephone, television, radio and computer industries are merging. As a consequence, the lines between these industries are no longer clear. The quality of cellular calls is rapidly approaching that of wireline calls, and wireless modems and local area networks are proliferating. Sophisticated workstations have audio capability. New compression algorithms even permit workstations to exchange video information in real time. And cable TV systems have begun introducing interactive features that enable them to go beyond their traditional broadcast mode of presentation.

Bellcore promotes research that extends beyond the traditional focus on circuit switched services primarily intended to serve voice and voice band data (modems) toward newer transport services that can flexibly accommodate voice, data, image and video on a common platform. Integrated Services Digital Network (ISDN), which is currently available in many central offices, represents a first step in this direction. Frame Relay, Switched Multimegabit Data Service (SMDS), Asynchronous Transfer Mode (ATM) and Synchronous Optical Network (SONET) are some of the other new services and technologies developed to meet the needs of computer communications and the national infrastructure. Frame Relay and SMDS are currently used by some Internet network providers, and will be available in over 40 cities by the end of 1993. Bellcore and various Bell companies are partnering with other industries and academia in the gigabit testbeds to develop useful services based on ATM and SONET standards. In addition, Bellcore is developing new applications such as Superbook(TM), a tool for browsing through multimedia information, and the Touring Machine, a working prototype of a future network infrastructure that

enables a wide variety of multimedia, multipoint, personalized applications to be supported by a shared public network.

Since 1980, the RBOC's and other LEC's have made significant investments in fiber optic technology to the extent that we now are well along the road to having a broadband transmission infrastructure. This fiber optic infrastructure collectively represents an important part of America's preparedness to support high speed information services.

However, the introduction of switching equipment which will fully exploit this underlying fiber optic infrastructure is just beginning. A number of telecommunication companies are commercially deploying broadband switching technologies and the industry is working on solutions to interoperability. It must also be noted that this commercial deployment of broadband capabilities is occurring in the same time-frame as public policy initiatives to build an information infrastructure and that to some extent the commercial rollout overlaps with some research efforts. Working together with the research community, the Nation has an unparalleled opportunity to ensure a common vision and course of action for industry and research.

The RBOC's are developing switched broadband networks. Public switched broadband networks will provide high speed connectivity for a wide range of applications, satisfying needs of both business and residence customers. The introduction of technologies that can efficiently and economically provide integrated access, transport and control is a major step in building that network. Those technologies can now support services such as Frame Relay Service and SMDS. These and future services will use the emerging high-speed multiplexing and switching technology of the ATM supporting the broadband platform. The next several years will see the emergence of standards and architectures for a multivendor environment capable of supporting real-time switched services on a point-to-point basis.

Given the natural evolution of technology, the infrastructure at any point in time is heterogeneous in terms of technology mix. Ten years from now a new vision of a new infrastructure will emerge. A demonstrated strength of the telecommunications companies has been their ability to integrate diverse technologies into a cohesive network. This will be an asset in the future as technological advances accelerate.

An example of RBOC development of new technology, known as Project Aurora, will be operational in the first half of 1993. It will bring the collective resources of Bellcore, Bell Atlantic, IBM, MCI, MIT, NYNEX and the University of Pennsylvania together in a cooperative research effort to better understand the practical aspects of high speed information networking vital to the success of the national information infrastructure. Project Aurora is one of several testbeds sponsored by organizations funded with federal support, in this case the Corporation for National Research Initiative (CNRI), which receives support from the Defense Advanced Research Projects Administration (DARPA) and the National Science Foundation (NSF). It is an example of the benefits that flow from successful partnerships among government, industry, and academia.

The RBOC's have also been involved in other aspects of the Internet. For example, NYNEX, Advanced Network & Services, Inc. (ANS, the provider of NSFNET backbone services), and Pacific Bell participated in a trial program to research the interoperability of SMDS technology with wide area IP networks. The trial simulated signals of data networking customers using NYNEX and Pacific Bell SMDS networks to gain access to the ANS network. The trial was a first step for all the participants to gain a better understanding of how SMDS and wide area TCP/IP networks might interact.

For the past several months NEARnet (New England Academic & Research Network, an NSFNET midlevel network) has been conducting an experimental trial of New England Telephone's (NET) Frame Relay Service. This trial, involving five NEARnet sites, has enabled NEARnet to evaluate NET's offering and to compare this technology with traditional leased line based services. Other RBOC's are contributing in similar ways.

The High Performance Computing and Communication (HPCC) Act, 1991 and the Computer Systems Policy Project (CSPP) report on "Expanding the Vision of High Performance Computing and Communications" focus on a set of user applications requiring relatively high bandwidth: interactive computing, multimedia communications, interactive video and remote access to supercomputers. We believe that the broadband services, can play a major role in achieving this vision. The introduction of digital switches, fiber optic links, and new services such as ISDN, Frame Relay and SMDS represent significant initial steps toward the realization of this vision. CCITT standards for ATM and SONET have been established, and are being implemented commercially by a variety of vendors. We believe that significant synergies will result if the implementation of Title VI encourages all local exchange companies

(LEC's) including the RBOC's to participate to the fullest extent possible in the development and evolution of a national information infrastructure.

It should be clear from our extensive experience and expertise in communications networking and services, and our proactive role in data and multimedia communications, that we and the RBOC's are well positioned to be major participants in a national information infrastructure. We look forward to the opportunity to partner with the government, other industry participants, and key user groups in developing a vision for a national information infrastructure and jointly implementing that vision.

II. SOME KEY ISSUES

The current mix of mature and experimental capabilities and networks is heterogeneous—some were developed by government, some by the computer industry and some by the telecommunications industry; some were developed jointly, some are subsidized and some are not; some are partly commercial and some fully commercial. We need to address clearly how to evolve from this current mix into a coherent framework in which the federal government should:

- foster research into applications and services that will provide for the needs of a broad range of users in K-16 education, health care and industries critical to U.S. competitiveness.
- encourage the continued development of a modern communications infrastructure by taking full advantage of private sector capital and communications expertise
- provide incentives for the development and deployment of new technologies and user-friendly interfaces to applications
- provide funds to needy entities such as schools, research institutions, libraries, and health care providers to enable them to meet their communications and information needs and develop programs which emphasize the network applications available to users through access and use of commercial services
- encourage collaboration among government, industry, academia and user groups
- promote interconnectivity and efficiency
- develop policy and resolve issues related to integrity, security, privacy and intellectual property

However, the federal government should not:

- build or operate production networks; and
- subsidize general usage of communications networks.

III. DEVELOPING A VISION

The support for a national information infrastructure and the benefits it can provide to society is so widespread that there is a ground swell of activity that is bringing together key stakeholders including K-16 educators, universities, libraries, government, all service provider industries (e.g., information providers, telecommunications, computer), and organizations representing these and other groups (e.g., FARNET, EDUCOM, CNI). These key cross-industry/cross-stakeholder groups are coming together to develop a consensus vision of the future national information infrastructure and the policy and technological transition steps necessary to get there. We are actively participating in many of these key efforts and are fully supportive of them. Such efforts will provide cross-industry/cross-stakeholder advice to the federal government in a constructive way that we believe will accelerate the development of a national information infrastructure. Some of the key activities in this area include:

- The private sector's Council on Competitiveness' 21st Century Information Infrastructure Project
- The Corporation for National Research Initiatives (CNRI) Cross-Industry Working Team
- The Harvard University Kennedy School of Government's Information Infrastructure Team

The private sector's Council on Competitiveness' project is aimed at establishing a vision for America's information infrastructure; articulating a strategy to achieve that vision; identifying specific/demonstration projects, R&D programs and regulations that can drive this strategy; and outlining a program for its implementation. The CNRI Cross-Industry Working Team provides a mechanism for cross-industry and cross-disciplinary collaboration in defining and solving the critical technological problems in creating a robust national information infrastructure. Its aim is to foster ongoing experimentation and development of technology and skills to accelerate the deployment of a world class national information infrastructure. Technological and architectural approaches developed by the CNRI Cross-Industry Team can feed

into the Council on Competitiveness' project. The Harvard Information Infrastructure Forum will identify key national information infrastructure issues and provide a forum for discussing concepts and ideas across all relevant stakeholder groups. This forum will also feed the vision being developed by the Council on Competitiveness.

Similarly, industry groups are actively involved, e.g., CSPP's "Perspectives on the National Information Infrastructure." We applaud CSPP's contributions, we share their perspective and are in basic agreement with the preponderance of their recommendations.

IV. SOME DESIRABLE CHARACTERISTICS OF A NATIONAL INFORMATION INFRASTRUCTURE

A national information infrastructure can bring the benefits of the information age to all segments of American society, improving the quality of life and enhancing U.S. competitiveness in an increasingly open global economy. Therefore, we support title VI's broad view of an infrastructure program which stresses the need to develop new networking technologies, as well as services and applications that will serve the urgent societal needs of a broad range of users and industries.

Universal access was, appropriately, not an objective of the NSFNET during the early period of technology development. However, it is a necessary feature of a national infrastructure that seeks to support hospitals, K-16 education and other important sectors of society that are widely dispersed and lacking in resources. Universal interconnectivity is necessary to ensure that any individual or institution that is connected to a network service provider has seamless access to all other individuals, organizations and information sources in the Nation, much as a subscriber to a local telephone company is guaranteed access to all other subscribers around the world.

Some existing applications such as electronic mail work well on today's networks, although not in a user friendly manner. They are not more widely used because many potential users are unaware of their existence. Other potential users find the interface difficult to understand. Many other existing applications that work well on today's networks can meet many of the needs of users in the K-16, library and other user communities, but are not widely used for similar reasons. The development of applications that have mass appeal and user-friendly interfaces that allow for simple and inexpensive access and use of existing infrastructure is therefore an integral part of the broad vision. This is consistent with section 604 (Applications for Education) and section 607 (Applications for Libraries) of title VI. These applications should be defined with input from the relevant user communities and providers, including the suppliers of enabling networks. Once the mass market is created, we would expect market forces to be the major driver of new applications.

Bellcore recognizes the importance of the training and education of users as a key factor in fostering and accelerating the emergence of the benefits of the national information infrastructure. To aid in the training of teachers, Bellcore initiated a program in 1990 called the Bellcore Teacher Institute (BTI). The BTI is a year long teacher support program with a one-month in-house session at Bellcore for 40 teachers from 14 school districts. Since its inception, Bellcore has supported over 120 teachers in this program. BTI is focused on enhancing the science, math, computing and telecommunications effectiveness of teachers through mentor relationships established between teachers. Electronic mail connections between and among teachers, their students and Bellcore technical professionals helps to maintain professional relationships and allows students in the classroom to interact with each other and with scientists at Bellcore. This program has also assisted in the formation of business/education partnerships in four districts and Pacific Bell is planning to draw from the results in the design of teacher training of the California Knowledge Network.

Bellcore has also created a Bellcore Roundtable on Educational Telecommunications (BRET). Other group members include representatives from New Jersey Bell, Stevens Institute of Technology, and the New Jersey Department of Education. BRET uses volunteers from Bellcore to visit teachers, students, and administrators to "popularize" telecommunications in the classroom. Other volunteers act as "angels" assigned to a particular school to help install equipment and software and be "on call" for questions. BRET's immediate goal is to increase the use of NJLink, a free online service available to New Jersey teachers that offers information such as current news, geography, bulletin board activities, curriculum ideas, and access to other New Jersey educators. The service is provided by the New Jersey Network in cooperation with the New Jersey State Department of Education. BRET also will be working on changing some of the barriers to telecommunications in the class-

room, such as lack of equipment, phone lines, training and insufficient internal support. There are many other efforts of this kind.

The development of new network technologies and leading edge applications in support of high performance computing and multimedia communication is also an integral part of the emerging infrastructure, as these developments lay the foundation for future services that will be more widely demanded. This goal is shared by title VI (section 701, 1).

V. A FRAMEWORK FOR A NATIONAL INFORMATION INFRASTRUCTURE

The RBOC's plans to evolve their telephone networks from narrowband analog technology toward new broadband digital services are consistent with the goals of title VI. It is important that title VI implementation and overall national telecommunications infrastructure development proceed in harmony toward a technically compatible system based on the best technologies, standards and services produced by each initiative. The use of ATM and/or SONET in all the gigabit testbeds suggests that the process of harmonization at the technical level has already begun. Our concern is that a similar harmonization of regulatory approaches with commercial needs has not taken place. If these issues are not addressed soon, there is a danger that the RBOC's will not be able to contribute effectively to the infrastructure, despite the best intentions of all participants.

Apart from these regulatory concerns, a framework that addresses the diverse needs of providers and users of the information infrastructure is a target structure comprised of separate Experimental Networks and Production Networks. Experimental Networks should consist of government supported testbeds (for example, the Gigabit testbeds) and high performance national testbeds (for example, interconnecting major supercomputer research sites) to support experimentation with leading edge networking technology and applications requiring such technology. Experimental Networks supported by the government should be used only:

a. To carry traffic directly related to the experimental goals of these networks, and,

b. By those researchers who need to perform applications that require the advanced technological capabilities of these networks, and which cannot be performed on Production Networks.

These Experimental Networks will be developed by partnerships among government, academia, private industry, and target user communities. These partnerships, which can build upon the long and successful collaboration between industry, academia and government, can leverage the government's limited resources to maximize social return.

Production Networks should consist of present and future commercially available communications networks. Production Networks would:

a. Be built, managed and operated by multiple providers from the private sector;
b. Provide a vehicle for technology transfer from their experimental counterparts;
c. Offer commercial networking capabilities to the business and residential population; and

d. Serve all users, including the research and education community, for those applications that can be supported by commercially available network services.

The government, private sector and key user communities should jointly implement transition steps to achieve this target structure.

One Key rationale for the creation of two component networks is that this distinction will serve end users by promoting network stability. Experimental Networks that are used as testbeds for new technologies will use unproven functionalities, resulting in a level of reliability that is unacceptable to those users who see the network as an integral part of their daily business activities. Another key rationale is that the partnerships which form the basis for Experimental Networks permit the government to leverage its limited resources to obtain the greatest social return. With appropriate incentives, government can attract commercial providers as partners on Experimental Networks and the partnership will have available the vast capital resources of the private sector to fund investment in the next generation of technology. Similarly, the transfer of technology from the Experimental Networks to the Production Networks will stimulate investment by the private sector and further leverage limited government resources. A structure for the continuing development of new technology and its transfer to the commercial structure will be put in place. The two component structure also provides a framework within which the research and education community can continue to be supported while ensuring all network service providers a fair, competitive market. Based on the funding recommendations below, government funds do not selectively advantage some providers, and create a disincentive for others to enter the market. Thus, the separation

between Production and Experimental Networks, based on separate facilities or on strict accounting and network control procedures, would promote stability, leverage limited government resources, promote fair competition, and provide incentives for private investment.

In "A Technology Policy for America: Six Broad Initiatives" (September, 1992), President Clinton states that "* * * the government can serve as a catalyst for the private sector development of an advanced national communications network * * *" In this role the government should fund and otherwise encourage the following activities:

a. Research into applications and services that will provide for the urgent needs of the broad range of users in K-16 education, health care and industries critical for U.S. competitiveness.

b. Research into user-friendly access and use of the networks and training programs to promote broad utilization by all members of society.

c. Direct subsidies to the research and education communities to support their access to and use of Production Networks.

d. Technical development of the Experimental Networks, e.g., the Gigabit Testbeds, including continued support of the research and education community's contributions to this effort. The telecommunications community has provided substantial resources to these joint efforts, helping the government to leverage its funds effectively.

The separation of Experimental and Production Networks will not, by itself be sufficient to ensure that newly developed technologies will be commercialized and deployed. This concern is expressed in the opening remarks of the legislation under consideration: "While the United States remains the world leader in science and innovation, it has not done as well as it should in commercializing and manufacturing new inventions." (102.2, p. 3). We share this concern and urge the government to strive for a regulatory policy that promotes fair competition, encourages innovation and allows for effective participation by all potential contributors.

VI. SPECIFIC RECOMMENDATIONS FOR S. 4, TITLE VI

We strongly support the thrust of S. 4. However, we have some specific recommendations for modification. First, in S. 4 as well as in most discussions and debate about the national information infrastructure, there is a need for further clarification about the roles of government and industry. We would like clarification on when a network is a "testbed" versus a working network, what is a trial application versus a working application, and what should be subsidized versus what should not. The telecommunications industry, as represented by the largest public carriers who provide telecommunication services to the majority of Americans, has developed a set of principles which specifically address these concerns (see the "Policy Statement" signed by the CEO's of 14 leading telecommunications firms issued on March 23, 1993). These principles articulate the role of government and industry in fostering information networks. We believe it is important for these principles to be adopted by the administration and Congress and we strongly suggest placing these principles into S. 4. These principles will clarify the issues raised above and provide a framework for cooperation among federal, state, and local governments, key user communities, academia, and the private sector in fostering information networks and the applications contained in title VI of S. 4.

Our second recommendation is that you consider requiring each agency responsible for developing specific leading edge applications to seek partnership where appropriate, in the design stages as well as throughout the development process, with key user groups (e.g., health care applications would involve private sector physicians, hospital administrators, etc., as appropriate) to assure the applications will best meet user needs. These agencies should also include advisors from the telecommunications, computer and related industries in the design and implementation of these leading edge applications. This will help assure the applications (when their development requires experimental technology) can feasibly be transferred from the experimental stage to the more widely available production stage over time.

Similarly, the technology associated with experimental networks and the development of the leading edge applications contained in S. 4 should give full consideration to the present and future developments of the computing, telecommunications, information and related industries. This principle will help ensure that existing technology is used if it can meet the needs of the leading edge application. Such applications should be developed on production/commercial networks. If existing technology cannot meet the application's needs, this principle will help ensure the maximum transfer of the best and most cost-effective technology when the applica-

tions and the associated technology are transferred from the experimental stage to the production/commercial stage.

Again, let me thank you for the opportunity to represent the views of many in the research community who share the goals of title VI, and who wish to contribute to the national information infrastructure initiative.

POLICY STATEMENT

The telecommunications industry, as represented by the largest public carriers who provide telecommunications services to the majority of Americans, strongly supports the initiatives outlined in the Clinton Administration's Technology Initiative paper of February 22, 1993. We have developed a set of principles which are consistent with the Administration's vision and which articulate the role of government and industry in fostering information networks. We suggest that the Administration and Congress adopt these principles as a framework for cooperation among federal, state and local governments, key user communities, academia, and the private sector.

We look forward to the challenge of evolving information networks to meet urgent societal needs, spurring economic growth, and strengthening America's competitive position in the global economy.

1. The High Performance Computing and Communications (HPCC) vision should be expanded to foster the emergence of services and applications that will serve the urgent societal needs of a broad range of users and industries, such as K-16 education, health care delivery and cost containment, manufacturing productivity and jobcreation, and the general public through telecommuting and access to libraries and other data bases. This imperative is shared with the recommendations of the Computer Systems Policy Project (CSPP).

2. This expanded vision can be most effectively served by a target structure comprised of separate Experimental and Production Networks. Experimental Networks should consist of government supported testbeds (for example, the Gigabit testbeds) and high performance national testbeds (for example, interconnecting major supercomputer research sites) for leading edge networking technology and applications requiring such technology. Experimental Networks supported by the government should be used only:

- (a) To carry traffic directly related to the experimental goals of these networks, and,

- (b) By those researchers who need to perform applications that require the advanced technological capabilities of these networks, and which cannot be performed on Production Networks.

These Experimental Networks will be developed by partnerships among government, academia, private industry and target user communities. These partnerships, which can build upon the long and successful collaboration between industry, academia and government, can leverage the government's limited resources to maximize social return.

Production Networks should consist of present and future commercially available communications networks. Production Networks would:

- (a) Be built, managed and operated by multiple providers from the private sector;

- (b) Provide a vehicle for technology transfer from their experimental counterparts;

- (c) Offer commercial networking capabilities to the business and residential population; and

- (d) Serve all users, including the Research and Education Community, for those applications that can be supported by commercially available network services.

The government, private sector and key user communities should jointly implement transition steps to achieve this target structure.

3. The government should encourage maximum interconnectivity and interoperability among Production Networks as an important goal of public policy.

4. The following four activities should be supported by the government and given the highest priority for achieving broad societal benefits:

- (a) Research into applications and services that will provide for the urgent needs of the broad range of users in K-16 education, health care and industries critical for U.S. competitiveness.

- (b) Research into user-friendly access and use of the networks to promote broad utilization by all members of society.

- (c) Direct subsidies to the Research and Education communities to support their access to and use of Production Networks.

(d) Technical development of the Experimental Networks, including continued support of the Research and Education community's contributions in developing these networks.

5. Full consideration should be given to the present and future developments of the computer, telecommunications, information and related industries when planning, designing, and implementing the technology and standards for the Experimental Networks. Giving full consideration to the developments in all these industries will help ensure the maximum transfer of the best and most effective technology from the Experimental to the Production Networks.

6. Decision making processes relative to government programs and associated funding should be open to the target user community, including K-16 educational institutions, libraries, the health care industry, and industries critical to U.S. competitiveness. The decision-making process should also include representation from the computer, telecommunications, information and related industries.

7. The government and industry should strive for a framework that promotes fair and open competition, encourages innovation, and allows for effective participation among all participants and industries. This would allow all participants in the Production Networks to contribute effectively towards the evolution of the national information infrastructure to satisfy future needs.

KEY BENEFITS

The set of principles embodied in this public policy statement provide a framework for continued development, growth and improvement of information networking capabilities in an ongoing economically sustainable way. Additional benefits include:

- Increased private sector investment in and continued development of a national information infrastructure will result from the government serving as a catalyst. Partnerships among the government, academia, industry and key user communities will focus on development of experimental technologies and leveraging limited government funds. The transfer of technology from Experimental to Production Networks will provide new capabilities to users, meet their expanding needs and increase industry's investment in the infrastructure.

- Alternative visions of the national information infrastructure can be integrated into a common vision of an infrastructure which provides interactive multi-media and other advanced networking capabilities to all Americans.

- Industry's incentive to invest in infrastructure will remain strong because there will be no government subsidies to Production Networks, and no commercial services will be provided on Experimental Networks.

- Selected end-user communities will be provided support for access to and use of networks and information through government funding. Supporting end user communities represents a shift of emphasis from the government's direct support of networks. These funds, predominantly grants, would be carefully targeted by the government to meet urgent societal needs by those end-user communities which otherwise could not afford to take advantage of the benefits that the infrastructure can provide.

- Ever increasing reliability and substantially improved operating standards will become available in commercial networks such that they can be matched to the critical requirements of end users.

- Alternative network suppliers will be able to interconnect seamlessly with each other resulting in a wide array of competitive choices that will spur innovation and result in competitive prices to end users.

The CHAIRMAN. Thank you very much, Dr. Lucky.
Mr. Joseph.

STATEMENT OF BRIAN E. JOSEPH, LABORATORY DIRECTOR, TOUCHSTONE RESEARCH LABORATORY

Mr. JOSEPH. Mr. Chairman, I am honored to appear before you to provide my thoughts on this comprehensive and well thought out piece of legislation.

In particular, I especially support the proposed financing for the development of technology. I specifically support the fact that this effort is going to be apparently private-side driven. I think that is

a very good idea. I think this is a necessity for the financial support to be successful.

Just as an anecdote, recently I went out west and visited with four companies that were all started by researchers coming out of Federal laboratories. In each case, I was shocked to find that each of these start-up companies were being financed by foreign sources. In talking with them at length and trying to understand where this comes from, I discovered that apparently the problem of the dried up venture capital was very real, that in this case the foreign investors were the only source of financing available. What really bothers me about this scenario is that we spend large sums of money developing this technology and I think it would be relatively inexpensive to assist in the venture capital to bring this technology into the marketplace.

Concerning the other programs, 80 percent of all the R&D spent by private industry in America is spent by about 200 companies. That leaves 20 percent of the R&D funds that private industry spends to be spread over hundreds of thousands of companies. And because of this, there is virtually no R&D spending in our small- and mid-size companies, with some very clear exceptions to that.

And the way we know that: My company, Touchstone Research Laboratory is in the business of applied research and development for hundreds of U.S. companies. We have hundreds of companies come to us every year. We solve manufacturing problems, we help improve quality. And there is a real need for more than just the high-end research. In America, as Mr. Prestowitz was mentioning earlier, we are very good at high-end research, the Nobel Prize, going to the Moon, doing all the really big things.

However, there is a real need in America for very small investments into companies, and I think this bill is very good and it has a holistic approach to it. On one hand this bill offers financing to companies with that need, and on another hand this bill offers small- and mid-size companies the engineering extension services, and this bill also supports R&D efforts. And I think that is absolutely excellent. I do not think that has existed before.

The reason that most U.S. companies are not looking to develop and are not looking to the future is because they have not found cost effective ways to pursue these activities in the past. And I think that this bill addresses this serious national challenge, or has the potential to address this challenge.

In summary, the prime mission of the bill is to make the United States second to none in development and deployment of technology and use of advanced manufacturing technology within 10 years. I am confident that this bill will do that. Thank you.

[The prepared statement of Mr. Joseph follows:]

PREPARED STATEMENT OF BRIAN E. JOSEPH

Dear Mr. Chairman, I am honored to appear before you here today to share with you my thoughts on a very important piece of legislation. I am very supportive of S. 4, the "National Competitiveness Act of 1993."

This bill describes how the federal government proposes to use taxpayers' money to stimulate the development of new technology, and the growth of technology-based manufacturing jobs in our country.

Any number of people can tell you how to spend large sums of money pursuing R&D projects which have little payback for our nation's manufacturing base. However, I come from a different perspective. My entire adult life has been devoted to

building a company with the sole mission to develop new technology and solve costly industrial problems for our nation's manufacturers so that these American firms can effectively compete in the world marketplace.

As a graduate student, I was offered a job as a researcher for Battelle Memorial Institute. Instead, a fellow graduate student and I decided to start our own business, Touchstone Research Laboratory, Ltd. Armed with our life savings of \$20,000 and an electron microscope which we purchased for \$101, we were determined to build an applied research laboratory which would develop new technology and provide industrial problem solving services for any manufacturer in the nation.

Every day for the past 13 years, the company we founded has been developing and adapting new technologies and providing cost-effective research for a very skeptical national audience of manufacturers who say, "We don't believe in research; we don't want to waste any money; but I want you to solve this technical problem that's costing me \$10,000 an hour, and I want your answer tomorrow morning." Amidst this very skeptical audience, and armed initially with only one piece of scientific equipment, my fellow graduate student and I have managed to build one of the leading independent R&D laboratories in the nation. Based on our company's five-year growth rate of 900 percent. Inc. Magazine listed us last year as one of fastest-growing private companies in the United States.

Today, our company is the R&D department and technology agent for several hundred U.S. manufacturers, from FORTUNE 500 corporations, to small- and medium-sized companies, and lone inventors. The manufacturing technology we develop is implemented, on the shop floor, within days, or weeks, of a problem being recognized. Touchstone's solutions to these manufacturing problems have an immediate, positive impact on the company's profitability, quality and competitiveness. We feel this accomplishment is significant to the issue of developing world-class competitiveness because, with our technical assistance, these U.S. firms are able to experience a substantial and rapid return on investment from their technology ventures. Many of the U.S. manufacturers we work with are able to report a return of investment of 1500 percent, or more, within 6 months. We know of no other research laboratory anywhere in the U.S. that has this mission or is so successful in these activities.

This is the perspective which I bring to this discussion of the "National Competitiveness Act of 1993." I am the co-founder of only one company; but as the R&D and technology agent for hundreds of companies throughout the U.S., I can offer the collective voice of some of these hundreds of American manufacturers.

The "National Competitiveness Act of 1993" is a very comprehensive and well-thought out piece of legislation. I'm confident that this bill will have a positive impact on how our country—both our government and our private sector—develops and injects technology into our nation's manufacturing base.

I am especially supportive of the proposed financing for the development of technology which is described in this bill, and its companion piece, H.R. 820. I support the fact that this proposed legislation relies on the private sector to determine whether to invest in new technology efforts. Also, providing government resources lowers the threshold of feasibility for the private sector to pursue these high-tech efforts. This will stimulate the private sector to pursue new technology and create, high-wage, high-tech jobs for our nation.

Government participation in these efforts will ease the private-sector pressures that focus on short-term profits rather than long-term economic growth. This, in turn, will facilitate the development of new technologies for our industries. This will also enable the technology which is developed to reach full maturation and full market impact. Ultimately, this arrangement will have the best long-term impact on our economy, our high-tech base, and our private investors.

The proposed government support of long-term investment capital and venture capital for U.S. firms interested in developing and commercializing new technology, as described in this legislation, will help respond to a critical need in our nation. Many innovative, American companies are unable to commercialize new technology because, regrettably, the only venture capital available to these American firms is tied to foreign interests.

On a recent trip out west, I visited four start-up companies, each of which experienced a similar fate in its efforts to commercialize new technology. Each company was founded by a former researcher in a federal laboratory who formed his business in an effort to commercialize products based on technology developed in a federal laboratory. In every case, each company pursued domestic venture capital for financing, but was turned down. Japanese venture capitalists stepped in, financed the commercialization of these new technological products, and obtained ownership of the rights to these inventions.

What is disturbing about the experiences of these four high-tech companies is that millions of dollars of taxpayers' money were spent to develop this leading-edge technology, but because of gaps in our domestic venture capital pool, foreign investors can own the rights to this technology for pennies on the dollar.

These scenarios indicate that our nation is suffering from critical gaps in investment capital to commercialize new technology. These gaps in our investment pool are forcing innovative American companies into a dilemma: either let their new technology rot on the shelf, or forfeit their destiny to foreign interests. Either of these scenarios will produce a dire future for innovative, American businesses. This lack of capital is weakening our economy and limiting our nation's future growth in the high-tech and manufacturing sectors.

We all recognize the importance of a sustained, effective effort to develop new technology for our nation's manufacturing base. This has been my life's mission. This is the focus of this important piece of legislation which we have before us today.

On the surface, the issue of developing appropriate manufacturing technology policy is straightforward, and can be solved by merely matching supply and demand. On the one hand, our manufacturing base is in need of new technology. On the other hand, we have abundant capabilities with respect to developing technology—namely our federal laboratory system and the nation's universities.

However, to properly respond to this situation, and develop effective technologies for our nation's manufacturing base, we need to understand the cyclical nature of private sector investment in R&D in this country.

Manufacturing R&D efforts have been very erratic over the past several decades. When the economy was strong, U.S. companies built elaborate research facilities and invested large amounts of capital in R&D activities. When the economy tightened, these R&D facilities, and the hundreds of researchers they employed, were among the first items cut from the corporate budget. This cycle of mismanaged spending and massive layoffs was detrimental to the U.S. industrial base, the research community, and the U.S. economy. Because their spending wasn't sustained or well-managed, the companies investing in R&D didn't enjoy a positive return on investment for their research dollars. Because of the massive layoffs, the labor force was robbed of career continuity, and the scientific expertise developed during this time wasn't used to its fullest. This cycle of mismanaged spending and massive layoffs has a negative impact on our economy, because without consistent R&D activities, we abdicate our role as an industrial leader.

The last, traumatic stage of this R&D cycle in the United States came in the late 1970s and early 1980s when many large, U.S. companies dramatically reduced their R&D activities and decimated their research staffs virtually overnight.

These layoffs didn't create a vacuum, where demand exceeded supply. Rather, this wholesale divestment of research efforts left a national R&D market that was polluted. American companies at that time viewed research as a senseless drain on company resources. Corporate managers felt their research efforts failed to create a positive return on investment for their company. Consequently, many U.S. manufacturers adopted a strategy to buy technology off the shelf from foreign competitors, and hence submit to becoming market followers, rather than take the risk of investing in research efforts to develop new technology.

Because of this polluted view of R&D in this country, we are at a point now where 200 U.S. companies spend 80 percent of the non-government dollars spent on R&D in this country. This means that the remaining 20 percent of R&D expenditures is spread out over the remaining several million companies in America. In other words, the vast majority of decision makers in corporate America is reluctant to invest in new technology. Consequently, the majority of U.S. companies spends very little money on technology to develop new products or improve current market niches. This is frightening; but this is the crux of the problem. And this is the problem which the "Competitiveness Act of 1993" is designed to address—why are the vast majority of U.S. manufacturers so reluctant to invest in R&D to develop new technology?

CHALLENGES

There are numerous reasons why U.S. manufacturers are reluctant to pursue new technologies. And each of these reasons represents challenges which the "National Competitiveness Act of 1993" must overcome in its mission to accelerate the creation of appropriate manufacturing technologies for our nation. These challenges include:

- Most U.S. manufacturers are stymied from pursuing new technology because they have never found a cost-effective, customer-responsive approach to solve the technical problems they face. The resources often cited as the technology saviors for

American industry, though valuable, fail because they are unable to respond to the specific needs of American industry.

- Universities and major laboratories tend to pursue expensive, "high end" high-tech programs. Most problems which prevent American businesses from competing effectively in the global market do not require "high end," expensive solutions. Rather, the key to enhancing American industries' competitiveness in the global market is to provide these companies with a series of cost-effective, customer-responsive solutions to the manufacturers' most prominent technical problems. Unfortunately, the technology which our manufacturers need to compete, isn't the technology which our government and universities had been pursuing. Because of this disparity between the supply of technology and industrial demand, our nation is very adept at building satellites, but in the meantime, we've lost our manufacturing base for VCRs, stereos and other consumer electronics. Our nation produces famous Nobel prize winners, but our manufacturers are forced to buy their new technology from foreign competitors.

- There is a cultural gap between the researchers in government and university laboratories, and the corporate managers who make decisions affecting their company's technology policy and spending.

- Because of these cultural differences, researchers at universities and government laboratories do not fully appreciate the importance of customer responsiveness or the critical time and financial constraints experienced in the private sector.

- The university environment is conducive to long-term, fundamental research projects. It is not conducive to producing timely, cost-effective responses to the changing demands of a dynamic manufacturing environment. Expecting a university environment to rapidly solve the day-to-day technical problems of a manufacturing firm will skew the educational mission of the school, and will probably prevent the manufacturer from continuing down the technology development path.

- Many U.S. manufacturers feel an adversarial relationship with the U.S. government. For mid-level managers in a manufacturing environment, regulatory agencies, such as OSHA and the EPA, are often more feared than a foreign competitor.

- For the past several decades, private sector R&D has been on a different path than government R&D. Government scientists and private sector engineers tend to speak different languages, operate in different cultures, and pursue divergent goals. Since World War II, America has spent more than a trillion dollars on R&D, yet we at Touchstone regularly see foundries who are battling the same mold wash, sand and basting defects these foundries experienced in the 1940s.

- The technology developed by the federal government and academia, although abundant, is not focused on solving the most critical technical problems experienced on the shop floor. In other words, the federal technology is valuable, but its value is not readily appreciated by those in industry who spend their lives in the manufacturing environment.

- The nation may have lofty goals of creating world-class manufacturing centers, centers for excellence, etc., but unless we, as a nation, address industry's most important needs (as determined by the individual manufacturer), we won't be able to change the mindset of industry and convince the key corporate decision makers that the pursuit of technology will produce a positive return on investment and long-term profitability.

SOLUTIONS

The challenges which have been preventing the majority of industrial America from aggressively pursuing new technology are numerous, but they are not insurmountable. It is possible to use limited resources and develop customer-responsive technology development services which provide a skeptical audience of manufacturers with a sizable return on investment. The Touchstone Model for Industrial Problem Solving, which has been developed over the past 13 years, has proven to be an effective, job-creation engine, capable of providing a substantial return on investment in a short period of time.

I fully support the goals of the "National Competitiveness Act of 1993." However, providing effective manufacturing technology expertise is a very difficult task. To maximize the impact of the government's involvement in this process, I offer you some suggestions based on my experiences.

- These efforts must be holistic. Provide a coalition of resources which can respond to the many needs of manufacturers, from availability of financing to cost-effective engineering assistance to solve the most pressing problems of industry, as defined by each manufacturer.

These efforts must be customer sensitive. Industry is reluctant to pursue new technology because the nation's most prominent technology-generating entities exist

in environments which prevent them from being responsive to industry's most important needs.

- These programs must be continually evaluated on a cost/benefit basis to ensure that they are customer responsive and cost effective.

- Cultural issues must be addressed. Businesses must be addressed in a language they understand. Every industry and every manufacturing firm in America operates under an idiosyncratic corporate culture which has been developed, and is constantly evolving in response to a complex manufacturing environment. The development of new manufacturing technology must consider these cultural issues in order to facilitate the rapid adoption of new technology in industry. The best way to infuse this "business" culture into a manufacturing outreach environment, and enhance customer-responsiveness in the outreach centers, is to hire former plant managers, plant engineers, etc. to manage these efforts.

- The "small" needs of our nation's manufacturing base should be addressed with the same zeal as our nation's large research projects. It is the cumulative effect of successfully solving numerous "small" technical problems that determines whether many U.S. manufacturing firms can compete in the global market. Large projects generate little return on investment for most small- and mid-sized businesses.

- Minimize bureaucracy. To be customer sensitive—especially in technology development and industrial extension—requires a goal to minimize "red tape."

- Work to the strengths of our nation's research universities. The holistic approach to manufacturing technology should allow universities to pursue activities which they are strongest at, i.e., long-term, basic and applied research.

The CHAIRMAN. Very good and we thank you.

Mr. Siegendorf.

STATEMENT OF W.J. SIEGENDORF, VICE PRESIDENT, HEWITT-ROBINS

Mr. SIEGENDORF. Good afternoon, Mr. Chairman, and thank you very much for allowing me to appear today. I am Bill Siegendorf and I am vice president of Hewitt-Robins in Columbia, SC. Hewitt-Robins makes rock crushers, screening machines, feeders, and other heavy machinery which our customers use in their mining and quarrying operations in order to process the minerals, metals, and construction aggregates.

Some of you came here today on roads made of crushed stone and you rode in automobiles made of metals extracted from the Earth. Our equipment makes this possible. We have been in Columbia since 1970, employing over 100 people with an annual payroll of about \$3 million. We employ engineers, welders, machinists, administrative, safety, and maintenance people, and we run the gamut on the educational scale.

Hewitt-Robins competes for business in the world market. We have to keep our quality high, our cycle times short, and our prices reasonable, and still make a profit. I understand that worldwide competitiveness is a prime objective of S. 4, and I think that Hewitt-Robins is an excellent example of the success of one of the pilot initiatives that you will expand on in your legislation. Our products are sold globally, our export sales are growing, and we are a partner in balancing the trade deficit.

Hewitt-Robins has benefited from the Manufacturing Technology Center Program. Our Hollings Center, the Southeast Manufacturing Technology Center or SMTC, is a partnership of our superior technical education system, the University of South Carolina, Clemson University, and Enterprise Development, Inc. of South Carolina.

Specifically, SMTC has helped us improve our competitiveness in the following ways. An analysis was performed on our computer-

ized drawing system because we want to upgrade it to Auto CAD release 12. The expertise and objectivity offered by SMTC people ensured that we spent our money on what was needed to do our job, and that we did not waste time and money on hardware and software unsuitable for our task and to our future needs.

The Hollings Center was also helpful in product refinement. We were having some real trouble with a structural member in one of our products. Their staff assisted us in a finite element analysis which identified the problem. SMTC was able to provide the skills and resources that we did not have available within Hewitt-Robins, and this saved us a considerable amount of time and money that we would have spent trying to resolve the problem by trial and error in the field, and that says nothing about the potential loss of customer confidence.

Computer-assisted design services were made available at a reasonable cost, enabling us to upgrade some old drawings of products which we still sell. Consequently, we completed this necessary task without diverting our design staff from working on current contracts for our products.

We also took advantage of many of the short course offerings on technical topics related to engineering and manufacturing. SMTC made these available at a reasonable price in proximity to our plant, and as a consequence we did not have to spend 2 days of travel time and expense for 1 day of learning. As a result, we sent more of our people.

SMTC was also invaluable in helping us with administrative functions. They provided an analysis of the effects of changing our business software, called MAPICS, over to a fiscal year basis from a calendar year basis, and also of the effects of adding material requirements planning and critical path analysis modules. Their guidance prevented the downtime and expense of correcting unanticipated problems with data after the changes and additions are made.

And it is especially satisfying from our standpoint that the Hollings Center came to us. We could have seen demonstrations at one of the technical college sites, but the Hollings Center staff joined us rather than vice versa, and they remain with us today through followup calls and visits.

In terms of indirect benefit to our people, the comfort level resulting from working with SMTC was really great. We are better able to utilize computer tools like CAD and MAPICS because SMTC smoothed the rough spots of uncertainty and kept us on track.

But we are not stopping here. In the immediate future, Hewitt-Robins will avail itself of at least two more services of the Hollings Center. We will be conducting an ISO 9001 audit so that we can plan to achieve this international quality standard.

Additionally, the networking aspect of SMTC's program has caught our attention. Through SMTC, smaller manufacturers like us will be communicating with larger manufacturers who can utilize our manufacturing capabilities and perhaps our products. And because of this, all of us will win without the need for them to go out of the State or, more importantly, to go offshore for their re-

quirements. SMTC can make us all more efficient in the marketplace.

Mr. Chairman, this is the simple success of Hewitt-Robins and the Southeast Manufacturing Technology Center. Our firm has made a commitment to technology and we look to SMTC as a permanent ally, one that will be with us over the next 5 to 10 years. What we are using in terms of off-the-shelf technology will evolve and change, and through SMTC we can find the knowledge, expertise, and objectivity to integrate these new technologies into our business.

Manufacturing gave us the standard of living that we enjoy today and we must strengthen our country's manufacturing base if we want to continue that standard of living. SMTC is providing a real means of doing just that and I urge you to continue your support and efforts on this program.

Thank you, sir, for your time, and I would be happy to answer any questions anytime you deem it appropriate.

[The prepared statement of Mr. Siegendorf follows:]

PREPARED STATEMENT OF WILLIAM J. SIEGENDORF

My name is Bill Siegendorf and I am Vice President of Hewitt-Robins in Columbia, South Carolina. It is a pleasure to appear before you today regarding the National Competitiveness Act of 1993.

Hewitt-Robins is in the business of manufacturing equipment for the feeding, crushing, and screening aspects of mineral recovery. Our customers utilize our product in their mine and quarry operations in order to process minerals, metals and construction aggregates which are so critical to our daily lives. From the roads we travel to the offices and factories which shelter our work to many of the conveniences found in our homes, the process begins with our equipment handling the raw materials necessary for their manufacture. As Congress and the Administration lead this country in refocusing on our integral infrastructure needs, Hewitt-Robins will be at the heart of this effort.

We have been located in Columbia, South Carolina since 1970. In this facility, we employ over one hundred people in manufacturing, sales and administration. Our annual payroll is approximately \$3 Million, and the economist would tell us the ripple of our economic impact on the surrounding community would be an additional \$3.5 Million. Within our family of coworkers, we utilize engineers with advanced training, metal tradespeople, administrative, clerical, machinist, and environmental safety and maintenance personnel. We span the range of the educational scale. Our operation is truly reflective of a small to medium sized venture.

As in any business, small or large, the measure of success is the bottom line. Hewitt-Robins competes for business in the world marketplace so we must keep our quality high, our cycle times short and our prices reasonable --- and still return a profit.

Indeed it is my understanding that worldwide competitiveness is a paramount objective of S. 4. Hewitt-Robins is an excellent example of the success of one of the early pilot initiatives to be amplified and replicated in your legislation. Our products are sold globally. Last year our revenue in international sales was approximately \$1 Million. We are a national partner in balancing the trade deficit.

Hewitt-Robins is the beneficiary of the Manufacturing Technology Center program. Our Hollings Center—the Southeast Manufacturing Technology Center (SMTC)—emanates from a Cooperative Agreement with the University of South Carolina and the National Institute of Standards and Technology. The Center is managed by Enterprise Development, Incorporated of South Carolina (EDI), a spin-off of our state economic development group, the South Carolina Development Board. The SMTC is a strong partnership comprised of the critical resources within South Carolina including our fine Technical Education System, the University of South Carolina, Clemson University and EDI. As a result, our relatively small state is blanketed with the expertise and support for people like us.

Specifically, the SMTC has helped us improve our competitiveness directly in the following ways:

- An analysis was performed of our proposed drawing system to upgrade to AutoCAD release 12. The expertise and objectivity offered by the SMTC personnel in-

sured that we spent our money on what was needed to do our job, not wasting time and money on hardware and software superfluous to our task. It is also significant that the computer materials were "off the shelf" rather than created especially for us. In a business as ours, the expense and commitment to custom software and hardware can be intimidating.

- The Hollings Center was also helpful in product refinement. We were experiencing a troublesome structural member in one of our products. The staff assisted us in a finite element analysis which solved the problem. SMTC was able to provide the skills and resources not available within Hewitt-Robins. This saved us a considerable amount of time and money we would have spent trying to resolve the problem by trial and error in the field.

- Computer Assisted Design services were made available at a reasonable cost enabling us to upgrade old drawings of products which are still sold. This allowed us to complete this necessary task without diverting our design staff from working on current contracts for our products.

- We also took advantage of the many "short course" offerings on technical topics related to engineering and manufacturing. The SMTC made these available at a reasonable price and in proximity to our plant. We do not have to spend two days of travel time and expense for one day of learning. As a result, we can send more of our people.

- The SMTC was also invaluable for administrative functions. They provided an analysis of the effects of changing our Manufacturing Accounting Production Inventory Control System II (MAPICS) software to fiscal year reporting instead of calendar year and the effects of adding Material Requirements Planning and Critical Path Analysis. This will prevent the expense of correcting unanticipated problems with data after the changes and additions are made.

- It is especially poignant from our standpoint that the Hollings Center came to us. Yes, we could see a demonstration at one of the Technical (college sites, but for our assessments, training and solutions, the talent was brought to us. Within our familiar workplace, we developed new skills and techniques. The Hollings Center staff joined us rather than vice-versa. They remain with us today through follow-up calls and visits.

Also, Mr. Chairman, in terms of the indirect benefit to our people, the comfort level resulting from working with SMTC is great. We are able to better utilize computer tools for our benefit. CAD and MAPICS are two for discussion—but it begins with the people. SMTC smoothed the rough spots of uncertainty. Our team is now ready for the next challenge.

But, we will not stop here. In the immediate future, Hewitt-Robins will avail itself to at least two services of the Hollings Center. We will be conducting an 1509000 (International Organization for Standardization) audit to bring us up to speed in international competitiveness parameters.

In addition, the networking aspect of the program has our urgent interest. Through SMTC, smaller manufacturers like Hewitt-Robins will be communicating with larger manufacturers who can use our products and services. Hopefully, all will win without the need to go elsewhere, out of state or more importantly offshore, for their needs. The SMTC makes us all more efficient in the marketplace.

Mr. Chairman, that is the simple yet significant success story of Hewitt-Robins and the Southeast Manufacturing Technology Center. And, we are not alone. I am told that SMTC has and continues to serve some 600 clients in South Carolina. Thus far, we estimate that Hewitt-Robins has saved or generated about \$25,000. Keep in mind—we have to sell over one quarter of a million dollars in products to generate that same return. When all projects are completed over the next 12-18 months, the total anticipated savings should be 3 to 4 times the initial savings. Obviously, the overall dollar impact cannot be pinpointed, but suffice it to note that the return on federal, state and private investment is remarkable.

Our firm has made a commitment to technology, and we look to the SMTC as a permanent ally—one that will be with us over the next 5 to 10 years. What we are using in terms of "off the shelf" technology will evolve and change, and through the SMTC, we can find the knowledge, expertise and objectivity to determine the relevance of these new technologies to our business.

Mr. Chairman, you and your colleagues are to be commended for your foresight and tenacity on the creation of the Manufacturing Technology Center program. I wish you every success and speed with the National Competitiveness Act of 1993 for additional centers and outreach programs. Speaking for the small manufacturer, we need it.

Thank you for your time and I look forward to any questions you may have at the appropriate time.

The CHAIRMAN. We want to thank each of you. We are going to leave the record open for questions. Several members wanted to submit questions to you and other members of the panel. We are very indebted to each of you really, for sticking around here and giving us this informed perspective.

I can assure you we are going to have to keep it going, as you indicate, Mr. Siegendorf, because it is a moving thing, it is very competitive, and what really you are attesting to is the tremendous need.

I know all of the witnesses and all of us in office lament the deficiencies in education. And we are going to have to step them up in the quality and get into math and everything else.

But when I got out of law school, I had to go down—a lady lawyer in those days, 40 some years, taught me how to search a title. And I had to watch other lawyers in the conduct of the trial of a case and those kind of things. And that is going to be the situation with modern technology and the explosion of research in technology. It is all going to have to be—we find at your technical training centers, I can speak directly with respect, let us say, to Mr. von Kumheimer of BMW, who is now locating a multimillion dollar facility there our of Munich, Germany, to produce these automobiles and everything else.

He tells, of course, of the apprentice courses for the skills. But he says, you have got it right here in South Carolina. And we are going to train everybody and all the workers right there. And they are sort of tailor-made training programs that you are not going to receive just in a BA degree or whatever else kind of degree you want.

The genius of our approach there in South Carolina is that we pattern the particular skill training to the particular need. Michelin wants to make a tire a certain way. In fact, they think it is a highly secret and parochial approach. We have 9,000 employees. They have got their own facility on one of our training college campuses. And equally, with many others that have come in.

So, we can all lament about education and how they do not know anything and how they got to retrain and everything else, but that is the nature of society today. If I had to go back into the coatroom, I would have to retrain myself.

And the lawyer who thought he knew it all 2 or 3 years ago, the doctor who thought he knew it all 2 or 3 years ago, is constantly being upgraded in the professions, as well as the industrial arts and skills.

So, this will help us play catch-up ball at the national level over the entire country. We have been very lethargic and very opposing of any kind of an assisted industry and yet the competition is totally assisted.

They want to talk about, one of the witnesses talking about profit versus market share. You go over there in Japan and the first thing they say, well, if you want to catch up, abolish your Securities and Exchange Commission. Very serious. Do not have to have a quarterly report. Just operate a kereitsu. And just have, instead of antitrust, have protrust. That is our competition.

Dr. Lucky, do not worry, we do not have money enough to pay for this hearing [laughter] much less start building communication

networks. I think that was perhaps a mistake on our wording of the bill. We had information infrastructure and I can understand the alarm. We have changed that to information research and technology and not infrastructure, because I think that is another thing good about this particular approach.

It is all industry-generated and then assisted by the Government. So, we are not picking the winners and the losers and that kind of thing. It all helps with the research. It all helps with continuing then with the outreach to implement the upgrading of the industrial arts and skills and approaches and computerization and what have you.

So, you have made a wonderful record and you have done it at a sacrifice to the committee. We are leaving the committee record open for questions from the several colleagues. And unless there is some further comment, the—oh, excuse me, Senator Gregg. This gentleman is quiet.

Senator GREGG. I just had a couple of questions I would like to ask of the panel. And I am probably going to pronounce your name wrong, Dr. Myhrvold.

I am interested, we have this issue and you make the point well in your statement that it should not—we should not just focus on the highway, but we have got to focus on the machines that are used on the highway.

But on focusing first on the highway, there is this issue of the debate between fiber optics and coaxial and the compression technology that Bellcore's put together.

And I guess the question for me is, as a pure amateur in this area is, the machines you are talking about which are totally interactive and have all sorts of capacity to communicate, both audio and visually, and they are very, I presume, portable; are they not inevitably require a medium that is up to speed to the machines?

And is that not inevitably going to mean we are going to need a lot more fiber optic capability? Or can this compression technology that has been developed by—maybe Dr. Lucky could comment on this—by Bellcore be competitive?

Dr. MYHRVOLD. Well, it is a very good question. I think the issue is not so much the bandwidth necessary for the machines, but for the applications. If you are looking for things that are based on text, for example, or voice, those kinds of data requirements are relatively small. Existing networks, such as the technology used in the Internet or ISDN is an excellent base for starting that.

You really have to view this as two separate issues. There is the bandwidth or how fast the information goes. Then there is the wide area connectivity, how far can you send it?

There is a set of applications that are very exciting that do not need very high speed, but they do need that long distance and they need to be ubiquitous. We have to find them everywhere, have a large market for it.

So, I would say the first step is to do what we can to provide leadership to the local public utilities commissions to help enable ISDN on as wide as scale as is feasible and tariffs that support this open model I was describing.

Now there are other applications such as watching a pay for view movie that do require higher bandwidth. Very few things actually

require fiber to your home for the same reason that the water main outside your house might be this big around, but the actual pipe that goes up to your house is more like this big around. You do not need all that data.

Probably a coaxial cable is enough for most people's uses, even for video, because of the advances in compression and other technologies.

So, I think we have got to invest in the infrastructure at every level. What makes sense to do at ISDN we should enable, because it can be done relatively cheaper today.

In the long term, I think that fiber optics will become the equivalent of those water main or the big high-tension lines. It will carry the bulk of the data. It might not go to most people's homes, however.

Dr. LUCKY. I would like to comment on that. I sense in your tone the question that many people have about the national information infrastructure—Is it gigabits for the advanced users or is it megabits for the masses?

And I would say it is both. I think to me the emphasis, as it is in this bill, should be on a broad interconnection. It should be interconnection for everybody at somewhat lower rates.

At the same time you want to promote the applications, the avant garde applications, at the higher rate, so you have experimental gigabit networks that connect together supercomputers and very advanced users.

And I do not see that these are incompatible. They can coexist as aims, one promoting the research and the other promoting the actual production networks which the masses have access to.

All my friends that work in compression feel that they are going to be put out of business next year by the fibers and all my friends at work on fiber worry they are going to be put out of business by compression. And every year they both go along kicking fine, because there is a need for both of these.

But you have to realize that high-definition television itself even is going to be sent at something less than 20 megabits and a fiber carries several gigabits, probably 10 gigabits in a year or so. So, the needs of today's services is not at those high levels, generally speaking, but they are going to grow. And it is a chicken and egg thing. We will pull them along with the high-speed experimental work.

Senator GREGG. I think you have answered my question. But I think my concern or my interest is that people like Microsoft are going to be driving the items that are going to be used on the highway and what type of highway are they going to need?

Dr. LUCKY. I think it works both ways, though. The capabilities they see on the highway and the network, they jump in and take advantage of. So, it definitely works both ways.

The network pulls out applications just as building roads creates business all along the roads. And at the same time, the applications drive the network. And I have never really found that one particularly is prime compared to the other.

Senator GREGG. Now you also make the point, Mr. Myhrvold, Dr. Myhrvold, that the Government could end up, because we are a slow moving entity by nature and a bureaucratic one, on top of

that, isolating new technology or maybe freezing in old technology that is not appropriate.

Do you have any suggestions for how we can participate in this process without atrophying it and calcifying it?

Dr. MYHRVOLD. Yes, I do, although I cannot claim I know all the answers right now. I think the issue is one of trying to set the high-level goals and set the priorities at the appropriate level. I do not think that extends down to the technical level of saying exactly which bits and bites get sent on this network. But there are some large issues of the business model that is involved.

For example, there are some people in the world that wind up using their networks and they charge you on the value of the information that goes. So, cable TV is in that business. If you pay for a pay-per-view movie, the cable operator takes a percentage.

That is very lucrative. That actually stimulates investment of the infrastructure. So, it is good in some areas. However, the phone company has a different model. They do not charge you any more to talk to your grandmother or your accountant. It is not the value of the call, just how long it takes, how many bits go, in essence.

Figuring out the balance between those is clearly a priority that merits national leadership. I think the issue of this openness, whether this is a service which is available to wide numbers of people to create new information businesses, that is a priority that I think can be set at the national level.

What the Government should not attempt to do is do the work that is better done by engineers who are on this 18-month treadmill I was talking about.

Senator GREGG. Are you suggesting that we in the Government should pick whether it is the cable company, the cable that goes into the home or the telephone cable that goes into the home?

Dr. MYHRVOLD. No, I am not suggesting that you should pick. But as part of the larger public policy issue of how this infrastructure evolves, you need to tend the seedlings planted by the research funding that is in S. 4. As those things progress, these issues will naturally arise.

They will arise because many of the industries involved are already regulated industries. They will arise because—I think it is an appropriate level for the Government to play a visionary role as Dr. Lucky was saying.

I am not suggesting that you pick. In fact, I suspect the right answer—although this is not a studied opinion here—I suspect the right answer is going to be finding a blend of these services, allowing companies that create these networks a sufficient scope for which they are happy to make the investments to get it to be, but also enough safeguards to make sure that it is an open platform which many people can play.

Dr. LUCKY. If I could just comment, too. I think that to minimize the risk of going wrong technical directions, it is very important that the process of governance be formalized and that that process be open to comment and to partnership with industry and to user groups. And every effort should be made to incorporate all that advice and to have a formalized system where we know what the rules are and everyone understands that.

Senator GREGG. Thank you.

The CHAIRMAN. And if there are any improvements in these rules, as we move along, I wish you would let us know, really, because that is how we are developing. And I think we have been very fortunate that we have started with the very restricted and initially continued to be a merit-based operation, a peer review, with the help of the National Academy of Engineering and otherwise.

So, we want to continue on that path. I know Mr. Scotty of Apple and Young of Hewlett-Packard said, instead of 7, we ought to have 170. But we are not going that fast or that far. But we will be accelerating it and we will be doing it because we have got your guidance.

The committee is indebted to each of you here this afternoon for sticking with us all day long.

Thank you very, very much. And the committee will be in recess subject to the call of the Chair.

[Whereupon, at 4:25 p.m., the hearing was adjourned.]

APPENDIX

PREPARED STATEMENT OF DR. ROBERT M. WHITE, NATIONAL ACADEMY OF ENGINEERING

Mr. Chairman, members of the committee, thank you for inviting me to present my views on national technology issues. In general the provisions of S. 4, the National Competitiveness Act are supportive of proposals of President Clinton and Vice President Gore as described in Technology for America's Economic Growth (February 22, 1993) and the Technology Reinvestment Project (March 10, 1993).

The general shape and intent of the policies and programs being proposed in S. 4 and by President Clinton represent important new directions for the government that I believe will do much to strengthen the national technology base on which our future economic growth depends. There is still much that is clouded by varying interpretations of the proposals. Presumably the shape of the President's proposals will become much clearer when the detailed budget implementing these proposals is forthcoming.

On the basis of my present understanding of both S. 4 and the President's proposal, I find the overall thrust to be the kind of commitment this country has needed to address the weakening technology position of our industry in an increasingly integrated global economy and a technologically interdependent world. President Clinton's proposals build on some of the programs commenced under President Bush but take a more expansive and forceful view of the role of the federal government to advance the technological capabilities of U.S. industry as does S. 4. The policies recognize that the principal burden of ensuring an adequate national technology base rests with the private sector in responding to market forces, and these policies seek to build closer working relationships between public and private sectors in their implementation. The proposals not only embrace a greater government role in the support of engineering and technological development but also provide for economic and tax measures to encourage private investment in plant and equipment that embody technological advance. They also support steps to buttress education necessary to provide a technologically able and literate work force. In short, these proposals seek better links between technology, economic, and human resource policies.

Reports of organizations such as the NAE, the NAS, the Competitiveness Policy Council, and others have in recent weeks addressed various aspects of the technology and competitiveness issue often in summation, recapitulation, and elaboration of views developed over the last decade or more. The ideas, concepts, and proposals on the national course are in full flood. What is new is that the excitement is matched by the prospect of funding these far-reaching programs.

As a broad generalization, the various proposals say that it is time that the United States government master a new unfamiliar and difficult role—shaping technology policy and programs for national economic performance. Indeed the NAE report issued this past week bears the title *Mastering a New Role: Shaping Technology Policy for National Economic Performance* and I have appended the executive summary of the report to this text. You will find in it a wealth of ideas, some of which I will note in my statement.

From time-to-time in our history, government has successfully invested in and guided technological development to address pressing national needs. Our agricultural enterprise and our aeronautical industry, for example, have been the beneficiaries of government intervention through the Morrill Act in the former case, and the National Advisory Committee for Aeronautics in the latter. We have also had our failures, as with the Supersonic Transport and the Synthetic Fuels Corporation. What we embark on now, however, is not directed specifically at any industry, but at the full range of our national technological capabilities where the government is not the main or sole customer.

The National Academy of Engineering has for some years focused its efforts on the relation of technology to economic growth and the competitiveness of U.S. indus-

try. We have examined the desirability and nature of a stronger government role in the advancement and diffusion of industrially important technologies. We have come to the conclusion that such an enhanced role for government is not only desirable but necessary in the face of deteriorating competitiveness of U.S. industry and the growth of technological capabilities in many nations of the world. This new governmental role must provide the economic, educational, trade, and technological environment to enable the private sector, responding to market forces, to ensure a continued technological leadership role for the United States. Only in this way will the private sector continue to provide the economic growth that generates jobs for our citizens and higher standards of living for all.

In a world in which comparative economic advantage derives principally from development and use of intellectual resources manifested in new technology-based products and services, we are perhaps better positioned than any nation in the world to maintain and increase our comparative economic advantage. The policies and programs now being considered are a major step in the direction of harnessing the incomparable intellectual resources that reside in our universities, industry, and government to reverse the trend toward diminishing world market share of U.S.-based production.

It is vital not only to ensure the creativity of the U.S. technological enterprise but also to translate that creativity into practice. Technological advance otherwise can be sterile in advancing our economic interests. Both S. 4 and the President's proposals wisely address this problem.

The many programs proposed add up to an overarching technology strategy that makes good sense. That strategy sets the following goals:

- Maintain and enhance the basic science, engineering, and education enterprise to provide a continuing flow of scientific knowledge, engineering invention, and an educated work force.
- Invest public funds, matched by private funds, in technologies on which both our national security and our economic comparative advantage depend through a new level of government/industry partnerships with initiative residing principally in industry.
- Strengthen technological capabilities of small and medium-size firms in cooperation with the states through establishment of extension services.
- Reduce the risk of private-sector investment in plant and equipment embodying technological advance and in research and development as a way of increasing the R&D intensity of the U.S. economy.
- Build the federal government technology effort largely on the basis of existing governmental institutions.

The proposed programs and projects to implement this policy are quite numerous, have different purposes, and are now the responsibility of different agencies. Some of these programs are intended for early implementation, such as those described in the Technology Reinvestment Program led by the Advanced Research Projects Agency (ARPA) but involving many other agencies including the National Institute for Standards and Technology (NIST) and the National Science Foundation (NSF). Other programs are proposed for implementation in the years ahead. The diversity of efforts, each under different agency management, implies an as yet unaddressed need for increased overall coordination and direction mechanisms if the national effort is to have some coherence.

Some agencies are clearly multipurpose technology agencies like the National Institute of Standards and Technology (NIST) or the National Science Foundation (NSF). We normally think of others such as the Department of Energy (DOE) as technology niche agencies. However, there are plans to broaden the missions of the DOE national laboratories to be general purpose technology agencies—witness the recent agreement between the textile industry and the DOE national laboratories to develop textile technologies.

The renaming of the Defense Advanced Research Projects Agency (DARPA) as the Advanced Research Projects Agency (ARPA) confirms the plans that it become a full-spectrum technology agency. We seem to be heading in the direction of clouding agency roles rather than clarifying them. I'm not sure this will serve the purposes of coherence. I'm impressed with the interagency agreement on roles under the leadership of ARPA on the Technology Reinvestment Project. Here we have a clear case of role and mission assignments within an overall framework. While I'm sure there was more to achieving this agreement other than funding control, there is a lesson here.

The distributed nature of the agencies responsible for implementing elements of the technology strategy argues for establishing some mechanism within the government to ensure a coherent total program. It is as if the sections of the orchestra have been identified and they have been given the monetary instruments and the

pieces of music they are to play. We now need a dynamic conductor to coordinate the efforts to bring forth harmony rather than dissonance. It is not yet clear who is to conduct this orchestra or what mechanism will be devised. I assume that the Vice president and the President's Science and Technology Advisor, who have been charged with guiding the federal science and technology programs, will establish the focus for this most forward looking national effort.

I would be remiss if I did not indicate some cautions and some suggestions as legislative and executive branch decisions are made.

- If the purpose of this national effort is to advance technology to assist the private sector to become more competitive in the world marketplace, then it is essential to find ways for greater industry participation in all phases, from planning to resource allocation and program evaluation. Only in this way will we address the problems of most concern to our industry. There will be overriding national interests that are not served by the operation of the free market, and in these cases the government will have to take the lead.

- To avoid supporting inefficient industries and companies, the various activities should primarily respond to initiatives arising in industry, either from individual companies or from consortia of companies willing to share significantly in the funding of technology efforts. programs such as the Advanced Technology Program (ATP), the Engineering Research Centers (ERC) Program, the Cooperative Research and Development Agreements (CRADAs), and some large ARPA programs such as the semiconductor Advanced Manufacturing Technology Program (SEMATECH) require this kind of match.

- To the extent possible, the programs must be insulated from inappropriate political pressures and resulting pork barrel resource allocations. In the 1992 report of a committee chaired by Harold Brown, former Defense Secretary, the Academies suggested serious consideration be given to a Civilian Technology Corporation which, free of civil service limitations, could involve in its leadership individuals with industrial backgrounds and would be better insulated from direct political pressures than government agencies. This concept deserves serious attention.

- Patience with the new programs will be needed. As I have indicated, our government needs to master a new role shaping technology policies and programs for economic performance. These efforts will not pay off immediately and some will fail.

- We should recognize that industrial extension services, while similar in concept to agricultural extension services, are very much different in operation. We are breaking new ground. Technology demand may not be the highest priority on the minds of those who run small businesses. We will need to find new ways of approaching the planned extension services.

- Finally, I cannot urge too strongly that funding be provided and that agencies be required to evaluate the individual programs as they go along. We are involved in a new, long-term learning experience, and unless we have adequate evaluation we will never know whether we have been successful or how to change direction.

This raises the question of how we will budge success. What measures of effectiveness will we use? No single measure will suffice. One measure must certainly be the extent of collateral private investment. Will industry provide matching funds for R&D? Will industry invest in this technology if with government assistance, developments are brought to the prototype stage? For some of the programs close to development of new products or designed to encourage investment in new plant and equipment, we may be able to evaluate whether new products and processes have been introduced which increase productivity. For those programs designed to train the work force, we can measure the extent to which newly trained individuals enter the work force in appropriate jobs. Other measures of effectiveness will have to be devised.

Mr. Chairman, I believe we are moving in the right direction. I would be pleased to answer any questions that you or the members of the committee may have.

PREPARED STATEMENT OF THE COMPUTER SYSTEMS POLICY PROJECT

PERSPECTIVES ON THE NATIONAL INFORMATION INFRASTRUCTURE: VISION, APPLICATIONS, AND RECOMMENDATIONS FOR ACTION

The Computer Systems Policy Project (CSPP), an affiliation of the chief executives of Apple, AT&T, Compaq, Control Data Systems, Gray Research, Data General, Digital Equipment, Hewlett-Packard, IBM, Silicon Graphics, Sun Microsystems, Tandem, and Unisys, is pleased to submit this statement for the record in support of title VI of S. 4, the National Competitiveness Act of 1993. The CSPP CEOs work together to develop and advocate public policy positions on trade and technology issues that affect their industry, all high technology industries, and the nation.

This statement focuses on three areas: CSPP's vision for the National Information Infrastructure (NII); the importance of a private sector-government partnership to deliver the NII; and applications where the NII will be especially beneficial.

America's standard of living is the world's best, and we have much to be proud of in our achievements as a country. However, we cannot be complacent. It is clear that we face new and increasing challenges as we enter the 21st Century. We must find new and innovative ways to rekindle economic growth, remain competitive abroad, and create the high paying high-technology jobs that will enable Americans to maintain and enhance their standard of living. We must be more productive and innovative in finding ways to maximize the role and involvement of every American citizen as we move quickly and efficiently into the Information Age. The United States is currently the world leader in computing and communications technologies, and an enhanced NII will put our information technology advantage to work for all Americans.

1. CSPP'S NII VISION

CSPP appreciates the effort and attention the Administration and the Congress have devoted to the vision we articulated in our January 1993 report, *Perspectives on the National information infrastructure: CSPP's Vision and Recommendations for Action*. In CSPP's vision, an enhanced NII will allow people—young and old, in rural areas and in cities—to access information and communicate with one another easily and securely, in any medium or combination of media—voice, data, image, video, or multimedia—any time, anywhere, in a cost-effective manner.

CSPP's vision focuses on the needs of users of technology. Technology must serve the end users, by making their lives better, more fulfilling, and more productive. The information infrastructure must function as a fully integrated system; it must be widely available and affordable. It is, after all, what technology can do for people that makes it valuable. The NII will put information technology to work for all citizens who want and need access to information, work, health care, education, job training, and entertainment.

The National Information infrastructure is far more than an electronic super-highway. In CSPP's vision, the NII integrates four essential and equally important elements:

- 1) interconnected and interoperable, commercially provided communications networks (carrying voice, data, video, broadcast, cellular);
- 2) computers and information appliances, including mobile devices, ranging from telephones and fax machines to servers, high performance computers, and supercomputers;
- 3) information resources, such as databases, applications, electronic libraries, printed materials, videos, and software agents; and
- 4) the people who build, operate, and use all of the above to create a whole new way of learning, working, and interacting with others.

This vision is attainable. In fact, major components and elements of the information infrastructure of the 21st Century are in place, or will be in the near term. The competitive market has been successful in delivering a great range of products and services for consumers to use.

But challenges are growing. Technology is evolving at an ever increasing pace. Some critical technologies, with long research cycles, are just too expensive for a single company to invest in. The marketplace for services and products is increasingly global in nature and many international markets are effectively closed to U.S. suppliers. A simple willingness to compete is not always enough.

2. GOVERNMENT AND INDUSTRY AS PARTNERS

These new challenges make a strong partnership between government and industry imperative. The private sector has appropriately taken the lead in developing and deploying the distinct elements of the NII—the networks, computers, services, and applications. Government's support and assistance have always been essential—and will continue to be just as important as we create and add new products and services to continue enhancing the information infrastructure. The U.S. has the most advanced and successful information infrastructure in the world, and we must all, in both the private and public sectors, remain committed to ensuring an enhanced NII to meet our nation's rapidly expanding information needs. Industry alone cannot successfully meet this challenge, however; we must have an effective partnership with government. The government can help by:

- leading the development of a vision and defining a national challenge;
- investing in research on precompetitive technologies and demonstration projects and supporting technology transfer;

- making appropriate government information easily accessible to the public;
- implementing a political and regulatory environment that encourages the development of new technologies and enables competitive markets;
- supporting and adopting industry-developed interoperability standards; and
- coordinating public and private action to address complex policy issues, such as access to the NII, privacy, security, carrier liability, intellectual property, and affordability.

Our challenge now is to find the ways to work together to deliver on the promise and reality of the NII.

Title VI of S. 4 Will Accelerate Deployment of the Infrastructure: CSPP strongly supports Title VI of S. 4, which will speed the development and enhancement of the information infrastructure by advancing research and the development of applications. In particular, we support the authorization of funds for demonstration projects that focus on health care, education, manufacturing, and digital libraries. Pilot projects and testbeds are essential to demonstrate the application of NII technologies in new areas and the benefits that they will make possible, such as the cost savings that may be achieved in the management of health care data; to accelerate the development of standards; to address the problems in scaling new technologies to meet the demands of many diverse users; and to bring together researchers from industry, government, academia, and the user communities in the development of solutions to difficult technology challenges.

CSPP's Recommendations for Title VI: While we strongly support Title VI and look forward to working with the Committee to get it passed, CSPP considers the bill would be further enhanced by making the following additions:

a. Add Funds for NII Research: Include funds for research in precompetitive, generic enabling technologies for an NII—the technologies that will enable the infrastructure itself—such as the following:

- research on the scalability problems associated with aggregating an extremely high number of widely distributed high, medium, and low speed users;
- technologies and architectures to ensure the security of information available in an NII and to guarantee privacy of information;
- interoperability of diverse systems and applications;
- integrity and robustness of networks and databases;
- new, more intuitive human/computer interfaces, such as speech and handwriting recognition and machine intelligence; and
- research on creating and managing distributed electronic databases and libraries, such as indexing databases, digitizing libraries, and organizing material.

b. Establish an NII Council: The successful development and deployment of a national information infrastructure requires a coordinated effort that includes participation by the private sector and a number of federal agencies. To accomplish this, CSPP recommends establishing a high-level, inter-agency, joint government and private sector body to develop a national vision of an enhanced information infrastructure, coordinate federal NII-related activities, and address complex policy issues, such as privacy, copyright, access to the NII, and interoperability.

3. NII APPLICATIONS

The following are brief descriptions, from Perspectives on the National Information Infrastructure, of some of the improvements the nation may be able to achieve through an NII.

Health Care: Today, America is facing a national challenge to improve the delivery of healthcare while reducing costs. An NII will offer new opportunities to improve the quality of and access to healthcare for Americans, while reducing costs by: improving management of and access to health care-related information; streamlining the processing of insurance claims through electronic payment and reimbursement; improving access to medical data and patient medical histories by healthcare professionals; enabling residents of rural areas and inner cities to enjoy the benefits of the latest medical technologies and expert opinions without leaving their home towns; and providing individuals in their homes with information on self-care and healthy lifestyle practices to better manage their own health. The following types of applications could help, in the near and longer term, to solve the health care problems the nation is experiencing:

- On-Line Patient Records—Patient medical information, including medical and biological data, would be available to authorized health care professionals anytime, anywhere (with privacy assured). This would enable health care providers to access immediately, from any location, the most up-to-date patient data, including medical images from tests, resulting in improved diagnoses and more informed treatment decisions.

- **Medical Collaboration**—Medical personnel will use interactive, multimedia telemedicine technologies to collaborate and consult with each other over distances. Doctors in hospitals or offices will consult on short notice with experts located anywhere in the nation; emergency room physicians will provide vital assistance to emergency medical personnel on the scene via wireless technologies. Patients and their doctors would have instant access—at affordable cost—to experts and specialists, no matter where the patient is located.

- **Surgical Planning and Treatment**—Physicians and surgeons will use high performance computers to facilitate medical diagnoses and treatment decisions, and to plan complex surgical procedures. Imaging and modeling techniques will be used to produce realistic and detailed 3D models of a patient's organ, to develop the most effective and safe surgical procedures, to demonstrate planned procedures to patients and medical students, and to develop alternate non-invasive treatments. With high speed networks, images could be transmitted instantly to experts located elsewhere for confirmation of diagnoses and treatment recommendations.

Education: An NII will be an essential tool for meeting the education challenges of the future. It will offer unprecedented potential for improving lives by making knowledge readily available and usable by all Americans. Education and lifelong learning applications such as the following would provide tools for addressing many of the learning needs the country is facing.

- **On-line Job Training Libraries**—Interactive, multimedia, digital libraries will be available on job sites to provide workers with task-oriented information that they could use, at their own convenience and pace, to improve and upgrade their job skills and performance. Workers in any job—assembly lines, retail outlets, sales, or offices—would be able to continuously upgrade their skills and learn new skills at any time through customized training libraries.

- **Electronic Libraries**—Students will use on-line electronic libraries in classrooms and at home to learn more about any topic. For example, if a student wanted to learn about the works of Shakespeare—or about a specific play—he or she will simply turn on a computer and, with the flick of a switch, be connected to the entire works of Shakespeare, complete with photographs, videos, and recordings. The electronic libraries will include software tools to help students find the information they need, identify relevant data, analyze, and present the information and will provide access to information and reference specialists to help users locate the material they need.

- **Virtual Laboratories & Field Trips**—Through virtual laboratories, students will perform science experiments using equipment and facilities located anywhere in the United States, including at the national laboratories, in collaboration with some of the nation's best laboratory scientists. Students will also take "field trips" to museums, observatories, science exhibits, and research centers without leaving the classroom.

- **Collaborative Learning**—Students of all levels and ages, teachers, and experts will collaborate, in real time via high capacity networks, on a wide variety of learning projects. The collaborators will access information and high performance computing resources located throughout the country, such as images collected by NASA's Earth Observing System satellites, and would work together to develop research projects that focus on their own interests.

Intelligent Manufacturing: Increasingly, to stay competitive, companies of all sizes must be able to respond rapidly to customer demands for high-quality products at low cost. This requires manufacturing and design processes that are highly efficient and flexible to enable the shortest possible design, development, and production times. Companies able to adapt and apply the latest information and communications technologies to their manufacturing processes will have an advantage over their less innovative competitors in the future. The challenge, therefore, is to develop, deploy and apply the technologies for a manufacturing infrastructure that incorporates computing and communications technologies to support integrated development, engineering, and manufacturing processes, and to enable applications such as:

- **Concurrent and Distributed Design, Engineering and Manufacturing**—Manufacturers of products, from automobiles to airplanes, and from machine tools to televisions, will distribute scheduling and production across geographically dispersed facilities to reduce production delays, minimize manufacturing, transportation, and inventory costs, perform design, engineering, and manufacturing concurrently, and leverage unique skills and availability of skilled resources. Large amounts of information, such as engineering modeling data, product specifications, test specifications, bills of materials, will be distributed and shared among dispersed facilities in real time.

- **Electronic Commerce for Manufacturing Enterprises**—Companies of all sizes will increase their efficiency and productivity while reducing costs by incorporating electronic commerce into their operations. Through links with suppliers, customers and local, state and federal governments, companies will be able to conduct virtually all of their essential business opportunities electronically, including: locating the best suppliers to meet their needs, identifying potential customers for their products, placing and receiving orders, exchanging payments, and ascertaining the latest government regulations affecting their businesses and submitting required compliance reports electronically.

- **Virtual Design and Manufacturing**—Manufacturers of complex, expensive products will use virtual design facilities to model, simulate, and visualize product designs and manufacturing processes in advance, saving the costs of building prototypes. Eventually, virtual reality technologies will permit product designers to “walk through” new products before actually building the products and through manufacturing facilities before production begins.

CONCLUSION

A clearly defined and coherent vision shared by the private sector and public policy makers is needed to guide the development of an integrated and interoperable NII. This vision calls for shared responsibility. The private sector should develop and deploy the infrastructure, guided by the forces of a free and open market. For its part, the federal government can accelerate the NII implementation by acting as a catalyst and a coordinator, and by funding research and demonstrations of applications, as it does in Title VI of S. 4.

Beyond the scope of S. 4, additional work can be done by both the private and public sectors.

Specifically, the federal government should:

- **Establish an NII Implementation Entity:** Establish a federal entity to implement the Information Infrastructure Council's vision, plans, strategies, recommendations, and other directions.

- **Develop a Public Education Program:** Request the National Research Council of the National Academies of Science and Engineering to develop, in conjunction with the private sector, a program to educate the general public about the potential benefits of an NII and the impact it will have on their lives.

- **Make Government Information Easily Accessible:** The National Research Council should assess federal information collection and dissemination policies and practices and make recommendations on how such policies and practices should be changed to make public information easily available and accessible to citizens through the NII. The NII implementation agency should be charged with developing a strategy to implement the recommendations across all affected departments and agencies.

Most of the work for achieving an enhanced NII must be done by the private sector. CSPP recommends that the private sector:

- **Continue investments to Develop and Deploy an NII:** U.S. industry must continue to work to develop and deploy the NII, including:

- deployment of interoperable communications networks;
- development of on-line databases and applications;
- development of easy to use computers and information appliances; and
- training people to design, develop, and use the various elements of the infrastructure.

- **Continue to invest in Research and Development of Applications:** Companies must continue independent and collaborative efforts to invest in research on NII technologies and development of new products and services.

- **Reach Out to Other industries:** CSPP is encouraging other industries likely to benefit from the applications made possible through an NII to join the effort to achieve an NII.

- **Promote NII Efforts:** industries should form a non-profit group to work with the National Research Council to promote an understanding and awareness of the benefits of the NII to end users.

- **Develop and Participate in Pilot Projects:** Industry should undertake an effort to develop strategic plans and facilitate the formation of teams to design technology demonstration projects in health care, education and lifelong learning, and manufacturing.

- **Develop NII Goals and Milestones:** The private sector will work with the federal government to develop specific examples of accomplishable goals for an NII, with concrete milestones.

Thank you for this opportunity to present the views of CSPP on title VI of S. 4. We look forward to working closely with this committee, and with the Administration and other members of the private sector, to further the evolution of the NII, and to deliver upon its promise for improving quality of life and enhancing our global competitiveness for the 21st Century.

QUESTIONS ASKED BY SENATOR BURNS AND ANSWERS THERETO BY SECRETARY BROWN

Question 1. Mr. Secretary, as you well know and understand, the private sector is building many telecommunications networks. This includes telephone companies, cable television companies, cellular telephone, alternative access providers, satellite providers, etc. Many contend that the proper role of the Federal government IS NOT to build and operate a competing telecommunications network and that if any Federal funds are spent they should be spent on research, user-friendly applications, and training programs to help educators, health care providers and other users obtain information. Mr. Secretary, do you believe that the Federal government should own and operate telecommunications networks which compete with those private sector networks established by private sector communications companies?

Answer. No. The Administration does not intend to create a network that competes with private sector communications providers. The private sector currently invests approximately \$50 billion annually in the U.S. telecommunications infrastructure. The privately owned networks funded by such substantial investment will continue to be the basis of the U.S. infrastructure. Even current Federally supported networks operating on a national scale, such as NSFNET, rely on facilities leased from private sector providers, and this relationship will not change. The Administration's program stresses a government-private sector partnership in which the Federal government promotes necessary technology development and demonstration, but does not become the national network builder or operator.

Question 2. How should the network be managed and by whom?

Answer. The private sector should build, operate and manage the nationwide information infrastructure. The U.S. telecommunications system is increasingly a "network of networks" operated by the private sector. The government should act as a facilitator of further development of this private sector infrastructure. It should aid basic research and development in telecommunications technology, stimulate efficient private sector investment, and promote interoperability among network providers. It should also seek to ensure that all people in the United States benefit from the nationwide information infrastructure. The infrastructure grant program to be managed by the National Telecommunications and Information Administration (NTIA) is intended to enable users that provide critical services to the public, such as schools and hospitals, to take advantage of the capabilities provided by advanced telecommunications technologies.

Question 3. On page 53 of the President's report entitled "A Vision of Change For America," the Administration states its intention to spend several hundred million dollars on "information highway" demonstration projects such as distance learning, remote medical monitoring and diagnosis, and telecommuting. Would it be reasonable to assume that private investment in the commercialization of such new technology and services by telephone companies, cable companies, satellite companies and others in the private sector would provide a better return to the American public? Do you see a situation where both government and the private sector develop such technology and services in competition with each other?

Answer. One area in which the "superhighways" metaphor has caused some confusion concerns the role of the private sector. Unlike vehicular highways, which are almost all government-funded and operated, the information superhighway in this country is privately owned and operated. This difference has created concern among certain segments of the private sector about the scope of the infrastructure initiative. However, this initiative is not intended to, and could not, supplant the private sector's role as the principal builder and operator of the telecommunications infrastructure. Rather, by funding demonstration projects in which advanced telecommunications capabilities are utilized to aid traditional social services (such as education and health care) as well as some forms of basic research, the Administration's information infrastructure initiative will complement, not compete with, private sector infrastructure efforts.

Question 4. Recently John Sculley of Apple and a number of other leaders in the computer industry released a proposal by a group called the Computer Systems Policy Project (CSPP). What is your position on these proposals?

Answer. These proposals are broadly consistent with the Administration's vision of a nationwide information infrastructure. I believe that they are also consistent with the work being undertaken to further develop the NREN, the Administration's plan to expand the scope of the High Performance Computing and Communications Initiative, and the Administration's proposal to support, through NTIA, the interconnection of schools, health care facilities, and providers of other social services that government traditionally has funded. In addition, the Administration agrees with CSPP that there must be closer cooperation between government and industry in this area.

Question 5. Mr. Secretary, some have suggested that the Federal government should lift the legal and regulatory barriers and restrictions—such as the cable-telco cross ownership restrictions and restrictions on local telephone exchange competition—which prevent the full development and utilization of the nation's information infrastructure. Do you believe that the time has come to lift or substantially alter these and other restrictions as a way of spurring infrastructure modernization by the private sector?

Answer. A key component of the Department's overall infrastructure strategy is leading the Administration's efforts to create the regulatory and legal environment needed to ensure the successful implementation by the private sector of the "information superhighway." Government assistance can effectively advance the telecommunications infrastructure only if it is provided in the context of rational, pro-investment, pro-competitive regulatory policies that encourage the private sector to develop and deploy advanced technologies. While there remain differences of opinion on the exact course to follow, there is increasing agreement that the policy gridlock that has characterized this area in the recent past needs to be broken. I can assure you that the Administration is very much aware that there needs to be a coherent relationship between government assistance for infrastructure development and government policies that directly influence private investment decisions in telecommunications infrastructure. The Administration is therefore evaluating the current legal and regulatory policies affecting telecommunications to determine what reforms are necessary to enable us to achieve our goal of an advanced nationwide telecommunications infrastructure. The White House Task Force on Information Infrastructure, in which NTIA will play a key role, will provide the high-level coordination necessary to do this.

Question 6. Mr. Secretary, do you view extending the information infrastructure to homes as importantly as networking manufacturing outreach centers, industry and research institutions?

Answer. Yes. The benefits of an advanced telecommunications infrastructure will only be fully realized if all citizens can use it. Initially, NTIA's infrastructure program would permit primarily institutional users with greater access to the benefits provided by networks like Internet. Access to advanced telecommunications networks from K-12 schools is not widespread at the moment. We hope to see that change dramatically as a result of NTIA's program. Although there are tremendous information resources already available in this country, the United States needs to make sure that those resources can benefit all of our citizens. Building an information superhighway will result in a stronger United States, economically and socially. The NTIA infrastructure development program will help make modern advanced telecommunications capabilities available at places such as schools and universities. As you have noted, the responsibility of bringing the infrastructure to the home is that of the private sector.

Question 7. Do you think S. 4 should more specifically note health care, education, and telecommuting applications for the home?

Answer. The applications that would be developed under the provisions of S. 4 as currently written will provide major benefits in education, libraries, and health care. These applications could result in better methods for teaching, improved access to digital libraries, and more efficient delivery of health care. Although telecommuting is not mentioned in S. 4, that use of telecommunications can have substantial benefits to U.S. businesses and families. The General Services Administration has a collaborative effort underway to establish several telecommunicating centers. We would be interested in examining further whether telecommuting should be specifically included in S. 4.

Question 8. Does NTIA and Commerce need any further legislative authority to pursue its information highway goals?

Answer. Under present legislative authority for NTIA's Public Telecommunications Facilities Program (PTFP), significant progress can be made in FY 1993 in developing the nation's information infrastructure. The Administration is currently reviewing relevant statutory language to determine the changes needed to enhance the program's authority to allow funding of a broad range of services to meet its

infrastructure development goals. While infrastructure funding under the present PTFP program is limited primarily to educational projects, the Administration expects to develop legislative proposals in the near future to expand the scope of the projects that can be funded through NTIA in order to help bring the full benefits of advanced telecommunications throughout the United States.

Question 9. Do you have sufficient staff and grant making experience at NTIA and Commerce to really get up and running quickly?

Answer. Administering this competitive grant program will require additional resources as proposed in the Administration's 1993 Supplemental Request. Currently, NTIA has a small, but highly specialized and experienced application review and grant monitoring staff with expertise in this area. This existing experienced staff, working with and directing the additional staff required to review and process the new applications expected under this program, will ensure that the program operates efficiently.

Question 10. I see in President Clinton's economic package that he has included \$64 million for a program for "information highways." Although we do not have all the details yet, it seems that this is a grant program for fiber optic or "broadband capacity highways." If this new program is approved how are you planning to structure it? Currently, Federal grant programs cover only capital expenditures not operating costs, will that become the case for this program?

Answer. The information highways program is not confined to broadband, fiber optic networks. In FY 1993, this program will be administered through NTIA's Public Telecommunications and Facilities Program (PTFP), which is currently limited primarily to educational communications. NTIA plans to fund competitively selected proposals that embrace a variety of academic interests, e.g., engineering, agriculture, K-12 instruction, adult learning, health education, and cross-cultural exchanges. Most of these projects are "last mile" connections to some "backbone" network that may use satellite interconnection, terrestrial microwave, copper wires and signal compression, or fiber optics. You could say that this program is building the on-ramps to the information highway. The supplemental 1993 funds (\$64 million) requested by the Administration for this program will be used to support projects, consisting of both construction and planning activities, that will help make modern advanced telecommunications capabilities available to schools, universities, and other educational institutions.

If the funds are appropriated, plans to solicit additional applications for infrastructure construction projects beyond those currently before the agency. The probable focus for these additional projects would be state and local governments. Applications for planning grants for advanced infrastructure development focused on education, health care, and other critical social services could be solicited from state and local governments, as well as from other entities such as universities or not-for-profit organizations involved in delivering these types of services to the public. These planning activities will establish a strong foundation for infrastructure development efforts in future years.

NTIA is coordinating its plans and programs with the HPCCIT which is the FCCSET subcommittee responsible for coordinating the overall HPCC program and its extension towards a National Information Infrastructure. Under the Administration's stimulus program, the NTIA program will competitively select projects to deploy information infrastructure technologies to provide services in the education community and in other communities within its charter.

This 1993 "information highways" program will provide the basis for information infrastructure activities in 1994 and beyond. The President has also proposed a package of \$500 million over the next four years for advanced public telecommunications infrastructure projects. As mentioned in the response to Question 8, the Administration plans to develop legislative proposals in the near future to expand the types of projects that can be funded through NTIA.

Commerce plans to work closely with the Federal HPCC program and ARPA to develop effective technology transition plans for incorporating advanced computing and networking technologies into the National Information Infrastructure. The scalable technologies being produced by the HPCC program will have broad applicability throughout the economy. The ARPA networking technologies are the foundation for today's Internet, which is the largest scale computer information infrastructure in the world.

Question 11. What percentage of the proposed \$784 million will be used to purchase broadband transmission capacity? How could we best insure that the monies that the Federal government spends in this area do not create broadband islands and bypass existing local networks?

Answer. [Note: The President's budget proposal for the NTIA infrastructure development program is \$718 million for FY 93-98.]

At this point, it is not possible to estimate the percentage of funds that will be used to support broadband transmission capacity directly. NTIA plans to fund competitively selected proposals by qualified applicants, such as state, local government, and educational entities, that best foster the development of the information infrastructure. We anticipate that such proposals will use a wide range of technologies, including fiber optic networks, to connect the "last-mile" users to the services that the nationwide information infrastructure will provide. Because NTIA has not yet begun to solicit or receive applications, the specific uses of the proposed funding have not been identified.

NTIA will seek to fund infrastructure grant projects that expand the reach of advanced telecommunications capabilities throughout the United States. In many cases, the facilities funded will be connected by providers of local services, including local telephone companies, cable companies, and NSAT network operators. NTIA does not seek to fund broadband "islands" that could inefficiently duplicate or "bypass" existing local networks, and will keep this issue in mind when implementing the infrastructure grant program.

Question 12. S. 4 calls for a dramatic expansion in the technology and manufacturing programs of the Commerce Department. What are the cost estimates for the activities and programs authorized under the legislation? Given that the total budget for the Commerce Department is approximately \$3 billion, can this agency accommodate the expense of the initiatives authorized under the bill?

Answer. S. 4 authorizes a total of \$782 million for Commerce.

- \$150 million in Manufacturing Technology and Extension;
- \$1.5 million for Benchmarking Science and Technology;
- \$210 million for the Advanced Technology Program;
- \$30 million for the Civilian Technology Loan Program;
- \$52.5 for the Civilian Technology Development Program;
- \$25 million for the State Technology Assistance Program;
- \$50 million for the American Workforce Quality Partnerships;
- \$1 million for Wind Engineering Research;
- \$12 million for the Technology Administration; and,
- \$250 million for NIST Intramural Programs in FY 1994. While Commerce will continue to work with the Committee concerning some provisions, it is clear that much of the bill comports with the President's Budget.

The Administration's plans for the Commerce Department include a tripling of NIST's budget—from under \$400 million now to about \$1.4 billion in 1997. This includes a doubling of NIST's basic research and development work over the next four years from \$194.9 in FY 1993 to \$400 million by 1997; growth of the Manufacturing Extension Partnership to create somewhere in the range of 100 manufacturing extension centers nationwide by 1997 and an increase in the Advanced Technology Program, including increased funding of \$132 million in FY 1994 rising to a program level of about \$700 million in FY 1997. In the areas of manufacturing extension services, the Advanced Technology Program and NIST Intramural Research, all the basic administrative and program support mechanisms have been established to manage these programs. We feel confident that Commerce will be able to carry out these duties efficiently and effectively. The Administration has chosen to increase these programs because of their excellent track record and the contributions they can make to U.S. competitiveness and technological growth.

Question 13. S. 4 expands the Manufacturing Technology Center's program at the National Institute of Standards and Technology (NIST). The program is aimed at helping small and medium sized businesses modernize and improve their operations. (1) What have been some of the success stories among small businesses that the MTC program has generated so far? (2) How many manufacturing outreach centers are contemplated under the bill and how much will the establishment of such centers cost?

Answer. (1) Attached are success stories from our Manufacturing Technology Center's program, including NIST Special Publication 830, "The Manufacturing Technology Centers Program: A Sampling of Individual Case Histories."

(2) S. 4 does not set forth a specific number of manufacturing outreach centers. However, the President's economic investment package includes about \$92 million for manufacturing extension in 1997. This funding level contemplates a program to create somewhere in the range of 100 manufacturing extension centers nationwide by 1997 to assist manufacturers to modernize their production capability. Federal funds, to be matched by state and local governments, will support and build on existing state, local and university programs, with the goal of creating the nationwide network of extension centers.

Question 14. How does the Manufacturing Outreach Program authorized under the bill compare with similar programs in Japan, which currently maintains 170 manufacturing technology centers to help its businesses?

Answer. We have not carried out an extensive study comparing the proposed DOC manufacturing extension program and the Japanese manufacturing technology centers. Dr. Philip Shapiro of the Georgia Institute of Technology, an American scholar most familiar with Japanese program, believes that DOC's current MTCs are analogous to the Japanese centers. Dr. Shapiro is currently in Japan studying their centers in more depth. Officials of the National Institute of Standards and Technology have been working with Dr. Shapiro and look forward to the results of his current studies.

Question 15. S. 4 provides increased authorizations for NIST's Advanced Technology Program (ATP). The ATP has been effective in providing multiyear grants, on a matching basis, to high-tech firms working on critical technologies. (1) What is some of the most promising research currently funded under the program? (2) What is the geographical distribution of the grants and is there an effort to ensure that the "have-not" states receive some of the R&D grants under the program?

Answer. (1) To date, the ATP has funded 60 projects including 18 joint ventures and 42 single-company projects. There is at least one project in each of the critical technology areas identified by the Office of Science and Technology Policy in its 1991 report. All of these projects involve promising research in a variety of areas including: (1) flat-panel display manufacturing processes, (2) x-ray point sources and x-ray optics for semiconductor lithography, (3) printed wiring board fabrication technology, (4) advanced magnetic, optical, and holographic computer data storage and memory systems, (5) neural network control systems for materials processing, (6) flexible, automated design and manufacturing systems, (7) advanced computing systems, (8) multiwavelength laser diode systems, (9) automotive precision assembly technology, (10) advanced composites for automotive structural applications, (11) plasma technology for low-cost diamond production, (12) advanced electrochromic materials, (13) the application of gene sequencing to clinical diagnostics, (14) genetic and tissue engineering, (15) advanced imaging and image compression systems, (16) natural handwriting recognition, (17) solid state and semiconductor laser systems, (18) advanced machine tools and controllers, (19) optical communications, (20) advanced thermal insulating materials, (21) automatic guided vehicles, (22) nanocrystalline ceramic materials, (23) high-temperature superconductors, (24) viral inactivation, (25) semiconductor and electro-optical materials processing, (26) chemical modeling for rational drug design, (27) human stem cell expansion, (28) diamond thin-film processing, (29) more efficient electrical power and refrigeration systems, (30) plastic recycling, and (31) advanced illumination technology.

To date, only one ATP project has been completed. This was a joint venture of Hampshire Instruments (NY) and McDonnell Douglas Electronics (MO), which resulted in the development of an x-ray point source that is now being incorporated into a prototype x-ray stepper for use in advanced semiconductor lithography. A number of other projects still underway have resulted in very promising early results. These include the development of: (1) a unique method for depositing integrated circuits on glass substrates that will soon be incorporated into products being produced by a U.S. flat-panel display manufacturer, (2) natural handwriting recognition algorithms being developed by an ATP small business awardee, that are being incorporated into a prototype application specific signal processing chip under development by a large U.S. manufacturer, and (3) the development of a promising new class of magnetic thin films that could provide the basis for a new type of non-volatile high-speed computer memory and also a new generation of high-density magnetic mass storage devices.

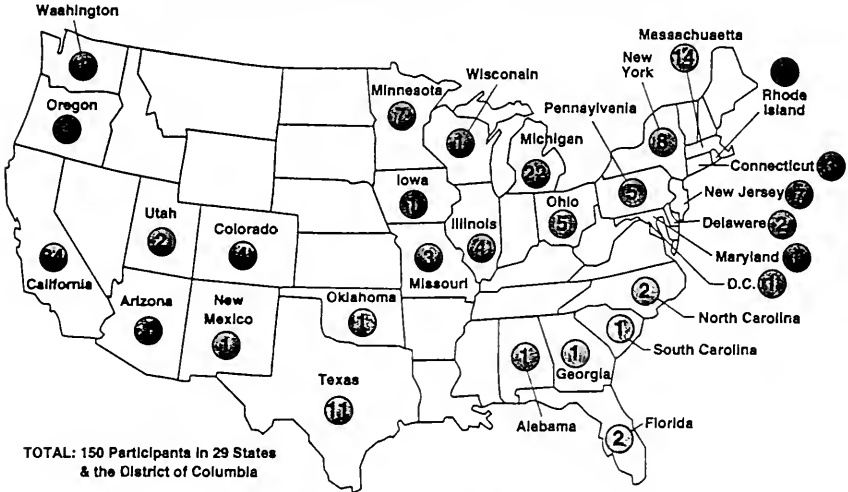
(2) Since these grants are competitively selected on their comparative merit, geographic distribution has not been a primary award criteria. The emphasis has been on funding the best proposals wherever they may be from. The 60 ATP awards involve 150 participants. "Participants" include 108 joint-venture partners and the 42 single-company award winners. This does not include subcontractors, informal collaborators with joint ventures, and collaborators and strategic (business) partners of single-company applicants, which would further expand the program's reach. The 150 participants are located in 29 states and the District of Columbia as shown on the attached map. In 3 competitions, twenty-six of the states have had a total of less than 10 applications submitted by companies within those states.

The ATP is actively engaged in a program aimed at increasing the number of proposals submitted from the low-application states. An ATP Senior Executive has been assigned the task of working with appropriate state and local economic development authorities, congressional offices, and the U.S. Chamber of Commerce, to identify companies in the low-application states that might have an interest in the ATP. We

are offering to hold workshops in these states to brief companies on ATP rules and application procedures and to give them an opportunity to ask questions. Hopefully, these workshops will result in an increase in applications from those states.

ATP COMPETITIONS 90-01, 91-01, & 92-01

ATP PARTICIPANTS* BY STATE



* "Participants" includes joint venture members, and excludes subcontractors, informal collaborators with joint ventures, and collaborators and strategic partners of single applicants.

Question 16. S. 4 contains several financing provisions that generated a great deal of controversy last year when they appeared in S. 1330, a similar technology bill. Specifically, S. 4 calls for a DOC loan program that would provide loans to high-tech firms for R&D. In addition, the bill would provide capital to critical technology investment firms which, in turn, would provide capital to high-tech firms. First of all, is DOC really equipped to manage loan and financing programs which, by their nature, could become very complex and unwieldy. Does DOC currently have personnel to implement such activities? Is it appropriate for the federal government to, in effect, compete with the private sector in providing capital for commercial ventures?

Answer. It is definitely not appropriate to compete with the private sector. If the private sector is meeting the capital needs of smaller high tech firms, then there is no reason for the Government to intervene. If it is not, then related questions must be answered. For example, we would need to explore whether the problem is a temporary one, whether private-sector solutions might be available and if not, whether there are other programs in the Government that could provide a solution, and whether the proposed program could be justified in terms of other federal priorities and the need to reduce the deficit.

These are the issues that I am exploring with my colleagues in the Administration. If, as a result of those consultations, the Administration concludes that a special program is warranted, we would make maximum use of existing capabilities in Commerce and other agencies, such as SBA.

Question 17. Past technology bills introduced in Congress ran into difficulty due to the opposition of the Bush Administration. Does the Clinton Administration support S. 4 in general? Does it support the specific funding levels for the DOC programs contained in the bill? Does it support the bill's loan and venture capital provisions to support the efforts of R&D firms?

Answer. The Clinton Administration strongly supports the objectives of S. 4. However, the Administration has a number of concerns. For example, we are not in a position to support the loan and equity financing provisions until we have completed an Administration review of technology financing. Although the Administration supports its goals, we do not believe that establishing a new grant program for American Workforce Quality Partnerships in FY 94 is appropriate given fiscal constraints and the need to prioritize investments. We would like to work with the Congress to develop a common position on this issue.

The bill's overall funding level for FY 94 is only \$39 million above what we are requesting, a difference of only 5 percent (\$782 million in S. 4 as compared to the Administration's request of \$743 million)

However, while the proposed overall authorization levels are roughly consistent with the Administration's request, we believe that the funding levels are inadequate for certain categories. For example, we are concerned that the bill authorizes no funds in FY 94 for upgrading NIST's lab facilities and authorizes only \$210 million for ATP. We have requested \$105 million and \$318 million, respectively.

QUESTION ASKED BY SENATOR PRESSLER AND ANSWERS THERETO BY SECRETARY BROWN

Question 1. I am concerned about Sections 322 and 323 of this legislation which would create a Civilian Technology Loan Program and Civilian Technology Investment Companies modeled on the successful Small Business Investment Company (SBIC) Program operated by the Small Business Administration (SBA). As the ranking member on the Senate Small Business Committee, I am very familiar with the SBIC program which provides over \$500 million each year in government financing—17 percent of this going to small businesses in the technology sector. Indeed, some \$1.6 billion of SBIC financing has been used, to date, to support advanced technologies. Successful companies helped by the program include Intel Corporation, Apple Computer, Cray Research and Compaq. (1) Why does the Commerce Department want to create a completely separate bureaucracy to operate a duplicate program? Put another way, what can CTICs do that SBICs cannot? (2) How large would this program be? Specifically, how much money would be lent and how many CTICs would be created? (3) What kind of staffing would be required by the Department of Commerce? (4) Why not just expand the SBA's successful SBIC Program? (5) Why would a company go through the trouble to become a certified CTIC when it could become a SBIC through the SBA, finance exactly the same high technology deals, AND be able to finance non-technology transactions as well?

Answer. (1) I want to emphasize that this proposal originated in the House counterpart to S. 4 and its predecessor, S. 1330. It is not a Commerce proposal, but we are reviewing its merits.

However, I agree with you that it should not be a duplicate program. It is my understanding that the bill's proponents do not conceive of it as such but, rather, as a complementary program because it is specially targeted to meeting the capital needs of small high-tech startups whose assets are essentially people and ideas. Such technology projects are in the earliest stages of development, and years of research must be performed before profits, if any, are generated. As a result, financing for these types of businesses is significantly different from typical small businesses, which seek funds for specific assets necessary to bring a clearly identified product or service to a defined market. It is unclear what portion of the 17 percent of SBA financing which goes to businesses that are classified as high-tech reaches the start-up companies most in need of this assistance. In addition, the programs proposed in S. 4 could also assist larger high-tech companies that are not eligible for SBIC financing.

(2) As proposed, a fully funded program under S. 4 would permit the Department to purchase or guarantee approximately \$600 million in securities issued by the CTICs. I cannot predict how many CTICs would be established at that program level. The most the Government could invest in any single CTIC is \$50 million. However, some investors would make the minimum investment of \$5 million in private capital or \$2.5 million for state or university sponsored CTICs, in which case the Government commitment would be much less (no more than \$10 million and \$5 million, respectively). Accordingly, there would likely be a mix of different sizes.

(3) S. 4 and H.R. 820 would impose a cap of \$5 million or 10 percent of appropriations, whichever is greater, on administrative costs.

(4) These are issues that I am exploring with my colleagues in the Administration.

(5) For reasons described more fully in response to Question 2(1), technology venture capitalists would likely prefer the nonparticipating security feature of CTICs.

Question 2. I am interested in the specifics of how the CTIC program would work. The Senate and House Small Business Committees, together with the SBA, just completed a two-year effort to reform the SBIC industry and have created something called a "preferred security." Under this reform, the government is allowed to buy equity in a small business and receive dividends, without the power to make business decisions for the company. This provides an additional means of financing and saves taxpayer dollars by allowing the government to share in the profits of successful businesses. Would this new development be a part of the CTIC program?

Answer. The CTIC program, as envisioned by the House, would also allow the licensees to issue a preferred security, but it would be nonparticipating—that is, the Government would not participate in profit sharing and would take a senior position to private equity capital. In other words, the Government would function as a patient lender willing to relieve the borrower of making current interest payments until it is a going concern, rather than becoming an equity partner.

This CTIC proposal attempts to channel funding to smaller high tech companies needing less than \$2 million and that may be years away from payoff, requires that specified percentages be invested in technology-based companies and in turn, a percentage of these investments be in early-stage technology investments. Accordingly, House staff has advised us that it believes, based on discussions with the financial community, that profit sharing under such circumstances would raise the risk factor to unacceptably high levels to attract technology venture capitalists or force the program to allow more investment to be made in bigger, later stage projects close to payoff. Were that to happen it would defeat the purpose.

Question 3. Through the creation of CTCs and the Civilian Technology Loan Program, the Federal Government will choose certain technological areas to receive preferential treatment. (1) How exactly will the U.S. Government choose which technologies should be promoted? (2) Do you believe the U.S. Government can pick and choose among U.S. industries more efficiently than market forces in making the decisions as to where capital is spent?

Answer. (1) H.R. 820 very clearly identifies the technologies considered “advanced” within the meaning of the Advanced Technology Program or “critical” as identified and updated by the Office of Science and Technology Policy. This provides substantial flexibility and breadth. Actual investment decisions will be made by the licensees within these broad parameters, so the specific decision would be driven by the market, not the government.

(2) No, but it is proper for Government to identify important national needs and, if they are not being served through normal market forces, to provide the necessary investment incentives consistent with budgetary constraints. For example, if market forces adequately valued small business formation as you do, there would be no need for an SBIC program, let alone a CTIC program. That is why President Clinton has made investment incentives the first order of business in his stimulus package. In this way, government is not making specific capital spending decisions; rather it is providing better access to capital for certain broad areas or critical generic technologies where there appears to be a market failure, e.g., a general lack of “patient” capital to fund technologies where the pay-off will take place very far down the road.

I should also reiterate that the bill's programs do not choose among industries, but support generic technologies that can create many new kinds of products and processes across a wide range of different industries.

ARAB LEAGUE BOYCOTT AND U.S. COMPANIES

Question 1. What is the U.S. Department of Commerce doing to further press the Kuwait is on this issue?

Answer. The Department of Commerce, which is responsible for the enforcement of the antiboycott provisions of the Export Administration Act, supports the work of the Department of State, which is seeking the discontinuance of the Arab League boycott of Israel by Kuwait and other Arab League countries. The Department of Commerce's Office of Antiboycott Compliance (OAC) assists the Department of State's efforts by providing State with information on boycott-related matters, based on mandatory reports which exporting firms file with Commerce, and Commerce's confidential advice service. Commerce also provides information and advice to State based on the extensive experience it has had with U.S. firms doing business in the Middle East.

Question 2. Do you view this matter as a fair trade issue since U.S. companies are being blacklisted by the Kuwait is?

Answer. The United States considers the Arab League boycott as a whole a fair trade issue because of the deleterious impact it has on the U.S. companies attempting to do business in the Middle East.

Question 3. Given Kuwaiti commitments after the Gulf War to end its boycott of American companies that trade with Israel, what can the U.S. Government do to press Kuwait on its commitment? How could Commerce coordinate its efforts with the State Department in this arena?

Answer. The Department of State is pressing Kuwait to live up to its pledge to end its boycott of American companies trading with Israel. Requests for information on progress in this regard should be referred to the Department of State. While the

Commerce Department does not formally coordinate its enforcement of the antiboycott regulations with State, it does work closely and meet regularly with State in overall efforts to enforce the regulations and ultimately to eliminate the boycott.

QUESTIONS ASKED BY SENATOR BURNS AND ANSWERS THERETO BY MR. MYHRVOLD

Question 1. As you both well know and understand the private sector is building many telecommunications networks. This includes telephone companies, cable television companies, cellular telephone, alternative access providers, satellite providers, etc. Many contend that the proper role of the federal government IS NOT to build and operate a competing telecommunications network and that if any federal funds are spent they should be spent on research, user-friendly applications and training programs to help educators, health care providers and other users obtain information. Do you believe that the federal government should own and operate telecommunications networks which compete with those private sector networks established by private sector communications companies?

Answer. In general, the federal government should not own or operate telecommunications networks when private sector communications networks can meet the government's communications needs. In some cases, special government needs, may require special purpose networks.

Question 2. How should the network be managed and by whom?

Answer. The "network" actually will be many interconnected and interoperable networks, each managed and operated by a private sector company. Just as today's network of long-distance, regional, and local telephone networks is managed and operated by a range of private companies, the networks of tomorrow will be managed by many different competing companies, including non-telephone companies.

Question 3. Tuesday, the CEO's of 14 major corporations issued a policy statement describing the key roles government and private sector should play in the deployment of the National Information Infrastructure. What do you see as the significance of this statement? What is your understanding of why the representatives of the public switched network (who by the way rarely agree about anything) felt it necessary to issue this statement?

Answer. Microsoft is pleased that the CEOs of 14 major telecommunications companies have announced support for the Clinton-Gore administration's vision of enhancing the information infrastructure. We believe that such cooperation will be necessary to obtain the required degree of interoperability and compatibility in a truly nationwide network. Indeed, this cooperation must extend beyond just the current public switched telephone network and embrace the cable television and computer industries, each of which will have a role to play and a contribution to make to the national information infrastructure.

Question 4. Mr. Lucky in your testimony, you note that Bellcore and the RBOCs are already participating in the development of numerous experimental networks? What is the role played by the RBOCs in these networks?

Answer. (Asked of Mr. Lucky only)

Question 5. Recently John Scully of Apple and a number of other leaders in the computer industry released a proposal by a group called the Computer Systems Policy Project (CSPP). What is your position on these proposals?

Answer. Microsoft has not taken position on the CSPP information infrastructure proposal. However, CSPP's vision of the information infrastructure of the future, as presented in its January 1993 paper, is consistent with Microsoft's.

Question 6. Some have suggested that the federal government should lift the legal and regulatory barriers and restrictions—such as the cable-telco cross ownership restrictions and restrictions on local telephone exchange competition—which prevent the full development and utilization of nation's information infrastructure. Do you believe that the time has come to lift or substantially alter these and other restrictions as a way of spurring infrastructure modernization by the private sector? Could you both briefly describe what policy, regulatory and legal reform is necessary to provide the incentives to the private sector to deploy a modern national information infrastructure?

Answer. Microsoft does not have a position on whether the federal government should lift the restrictions on cable-telco cross-ownership and on local telephone exchange competition. In general, however, we would encourage the government to look at ways to increase competition in the provision of information services to homes and other users.

While I am not qualified to discuss the range of policy, legal and regulatory reforms necessary to provide incentives for the private sector to deploy an advanced NII, I am convinced that technical advancements will soon make possible a variety

of new services that could be provided by cable companies, telephone companies, television broadcasters, and other industries.

Question 7. Do you view extending the information infrastructure to homes as importantly as networking manufacturing outreach centers, industry and research institutions?

Answer. Yes, extending an enhanced information infrastructure to homes is as important as extending it to businesses and research institutions. The home market for new services and the machines that will make them possible will help create the demand that will stimulate investment in the infrastructure by the private sector. As I noted in my response to questions from Senator Gregg, however, this does not necessarily require installing fiber optic cable in homes in the immediate future. New technologies will permit access to new types of services from homes through a variety of media and technologies.

Question 8. Do you think S. 4 should more specifically note health care, education, and telecommuting applications for the home?

Answer. I believe S. 4 adequately addresses these issues.

Question 9. Does NTIA and Commerce need any further legislative authority to pursue its information highways goals? Background: President Clinton's economic proposal includes a program for "information highways." [Appendix, Table 4] For Fiscal Years 1993-1995, the total for this program is \$64 million. For fiscal years 1994-1998 an additional \$275 million has been proposed. [Appendix, Table 5] Generally, federal grant programs are used for capital expenditures not operating expenditures. If this program is structured like other federal grants, there is the danger that it would require the grantee to construct the fiber optic network. Although the constructor would own and control the network, this would duplicate the fiber optic networks that various communications companies are currently constructing. To avoid this duplication, these federal grant monies could be used for long-term leases from these communications companies. This would insure that federally funded fiber optic construction would not be wasted or redundant networks and that all consumers would benefit.

Answer. Until more detail is provided by the Clinton-Gore Administration on the Commerce Department's goals for information highway initiatives, it is difficult to assess the adequacy of existing legislative authority. If support for precompetitive R&D is a goal of the Department, S. 4 is a good first step at providing the necessary legislative authority.

Question 10. I see in President Clinton's economic package that he has included \$64 million dollars for a program for "information highways." Although we do not have all the details yet, it seems that this is a grant program for fiber optic or "broadband capacity highways." If this new program is approved how should it be structured? Currently, federal grant programs cover only capital expenditures not operating costs, should that be the case for this program?

Answer. My understanding is that the funds identified for "information super-highways" would go to potential users—schools, public libraries, etc.—to fund connections to the Internet. These would not likely involve the construction of new fiber optic networks, but would provide funds for the recipients to purchase connections to network services.

Question 11. On page 53 of the President's report entitled "A Vision Of Change For America," the Administration states its intention to spend several hundred million dollars on "information highway" demonstration projects such as distance learning, remote medical monitoring and diagnosis, and telecommuting. Would it be reasonable to assume that private investment in the commercialization of such new technology and services by telephone companies, cable companies, satellite companies and others in the private sector would provide a better return to the American public? Do you see a situation where both government and private sector develop such technology and services in competition with each other?

Answer. It is my understanding that the funds proposed by the Administration for demonstration projects would go to private sector contractors or grantees, with some level of matching funds contributed by the private sector participants. The demonstration projects should be awarded competitively, on a merit basis, to ensure the best quality projects. Further, to avoid competing with ongoing private sector efforts, the demonstration projects should focus on research on pre-competitive technologies and on large-scale integration of new technologies that is not being done by the private sector.

QUESTIONS ASKED BY SENATOR BURNS AND ANSWERS THERETO BY MR. LUCKY

Question 1. As you both well know and understand the private sector is building many telecommunications networks. This includes telephone companies, cable television companies, cellular telephone, alternative access providers, satellite providers, etc. Many contend that the proper role of the federal government IS NOT to build and operate a competing telecommunications network and that if any federal funds are spent they should be spent on research, user-friendly applications and training programs to help educators, health care providers and other users obtain information. Do you believe that the federal government should own and operate telecommunications networks which compete with those private sector networks established by private sector communications companies?

Answer. The proper role for the Federal Government is to foster an environment that enables consumers, businesses, government officials, educators, health care providers and others to realize the full potential of telecommunications. Such an environment can best be created through a mixture of policy decisions and tax incentives that encourage the private sector to invest and innovate. Current federal policies serve as disincentives to investment and innovation. Congress and the Administration should work in concert to eliminate those disincentives.

It is also appropriate for the Federal Government to stimulate research, the development of applications and training that enable public interest constituencies—health care providers and educators, for example—to harness technology to serve the public good. Funding of noncommercial research, application and training projects would fall into this category.

It would be most inappropriate for the Federal Government to enter the telecommunications business in competition with the private sector. For the Government to offer telecommunication services would seriously undermine the notion of commercial networks, would be enormously costly, would fly in the face of a global trend toward privatization and would likely retard technological innovation.

In addition, the government should not subsidize networks that provide capabilities which are available on commercial networks. Such subsidies give these networks a competitive advantage over other commercial networks and provide a disincentive for investment by the private sector. There should be a shift in emphasis from subsidizing networks to increased support for those end users communities selected by the government (e.g., K-12 education, libraries) for their access to and use of commercial networks.

Question 2. How should the network be managed and by whom?

Answer. Technical evolution and interoperability of commercial telecommunications networks are addressed collectively at present by service providers, state and federal regulatory agencies, and appropriate industry associations, and regulated economically by the state and federal regulators. Issues of network standards, access to, interconnection, numbering, etc., are resolved by cooperative processes and formally adjudicated only as a matter of last resort. While this process sometimes proves cumbersome and time-consuming, it is somewhat like the old adage about democracy being the worst form of government ever invented—except for everything else.

As multiple commercial networks expand, it is absolutely imperative that there continue to be a point of central regulation. The FCC has historically fulfilled this role and should continue to do so.

Question 3. Tuesday, the CEO's of 14 major corporations issued a policy statement describing the key roles government and private sector should play in the deployment of the National Information Infrastructure. What do you see as the significance of this statement? What is your understanding of why the representatives of the public switched network (who by the way rarely agree about anything) felt it necessary to issue this statement?

In their March 23rd statement, the chief executives of the nation's leading local and long distance telecommunications companies articulated a common vision regarding the roles of government and industry in furthering an information infrastructure. Significantly, these business leaders, who compete fiercely and frequently with one another (and who are arguing in favor of continuing to do so), are in agreement that government effort and expenditures should be largely directed to research applications and fund access to commercial networks. The policy statement introduces the concept of Experimental Networks—government-supported testbeds and research networks of advanced technological capabilities—and Production Networks—commercially available networks.

The statement of policy and principles was offered to sharpen the focus on how communications technology can best be harnessed to serve the public good. As policymakers and industry leaders have advanced the notion of "electronic super-

highways,"there has been some concern over whether the Federal Government intended to build and operate that system, as it has the interstate highway system. There has also been concern that the government would continue to subsidize networks which provide capabilities available on commercial networks. Telecommunications industry leaders, whose companies have invested billions of dollars in the information infrastructure, are obviously opposed to government competing in historically commercial enterprise. The policy statement underscores that there is an appropriate and important role for government, but that it is co-operative, not competitive.

Question 4. Mr. Lucky in your testimony, you note that Bellcore and the RBOCs are already participating in the development of numerous experimental networks? What is the role played by the RBOCs in these networks?

Answer. The Gigabit Testbeds are administered by the Corporation for National Research Initiatives, with funding from the NSF and DARPA. These testbeds are used for research on new network functionalities and to determine which applications need gigabit speeds. As an article in the October 1990 issue of the *Scientific American* describes, every Gigabit Testbed is supported by at least one RBOC, and all seven RBOC's are involved in at least one testbed, either directly or through Bellcore.

Specifically:

- AURORA's participants include Bell Atlantic, Bellcore and NYNEX.
- BLANCA's participants include Ameritech, Bell Atlantic and Pacific Telesis.
- CASA's participants include Pacific Telesis and US WEST.
- NECTAR's participants include Bell Atlantic and Bellcore.
- VISTANET's participants include BellSouth.

In addition, Bellcore, Southwestern Bell and US WEST are participants in the Magic Gigabit Testbed, which is directly funded by DARPA. Each RBOC participates in a variety of other research testbeds that are too numerous to mention here. The RBOCs contribute their technological expertise and, in some cases, provide the intra-LATA facilities used by the testbeds.

Question 5. Recently John Scully of Apple and a number of other leaders in the computer industry released a proposal by a group called the Computer Systems Policy Project (CSPP). What is your position on these proposals?

Answer. The CEO's of fourteen of the largest telecommunications companies stressed as the first point in their Policy Statement that " * * * the High Performance Computing and Communications (HPCC) vision should be expanded to foster the emergence of services and applications that will serve the urgent societal needs of a broad range of users * * *", and concluded: "This imperative is shared with the recommendations of the Computer Systems Policy Project (CSPP). The CEO Policy Statement goes further than the CSPP in defining a policy structure that will allow government, private industry, academia and key user communities to cooperate in the complex task of building an information infrastructure while preserving incentives for the private sector to invest in support of this joint effort."

Question 6. Some have suggested that the federal government should lift the legal and regulatory barriers and restrictions—such as the cable-telco cross ownership restrictions and restrictions on local telephone exchange competition—which prevent the full development and utilization of nation's information infrastructure. Do you believe that the time has come to lift or substantially alter these and other restrictions as a way of spurring infrastructure modernization by the private sector? Could you both briefly describe what policy, regulatory and legal reform is necessary to provide the incentives to the private sector to deploy a modern national information infrastructure?

Answer. In an April 15 meeting with Vice President Gore, representatives of the former Bell companies said they could increase planned infrastructure spending by about \$100 billion if they were allowed to earn back the investment by creating and selling new products and services. Under a current business plan scenario, the Regional Bell Operating Companies envision \$350 billion of infrastructure investment by the year 2015. That number could grow to at least \$450 billion if lines of business restriction in the Modification of Final Judgment and the 1984 Cable Act are removed.

The current restrictions retard innovation and investment. Given the rapid convergence of information, communications, computing and entertainment, the discrete lines of business envisioned by the restrictions are not sustainable. If the RBOCs are permitted to exploit the full potential of their networks, there is obviously incentive to increase investment in those networks and in products and services that utilize the networks.

Question 7. Do you view extending the information infrastructure to homes as importantly as networking manufacturing outreach centers, industry and research institutions?

Answer. It is extremely important that the information infrastructure be extended to the home. The inclusion of residences in the network is necessary if K-12 school children are to use network resources as part of their homework assignments, if doctors are to be able to communicate effectively with hospitals, clinics and pharmacies from their home offices, if employees are to telecommute, and if electronic communities are to supplement community centers for the disabled and others who find travel inconvenient. The extension of the infrastructure to the home benefits businesses as well as residences and is clearly in the national interest. However, it is worth noting that business and residences are likely to have different needs, and different services consequently capabilities may have to be developed to serve the particular needs of different sectors (and even sub-sectors) of the economy. The government should strive for a unified infrastructure to which all Americans have access, and let the market determine the specific services that will be offered to each sector using that infrastructure.

Question 8. Do you think S. 4 should more specifically note health care, education, and telecommuting applications for the home?

Answer. In my opinion, it would be helpful if the points made in #7 above were included in the legislation.

Question 9. Does NTIA and Commerce need any further legislative authority to pursue its information highways goals? Background: President Clinton's economic proposal includes a program for "information highways." [Appendix, Table 4] For Fiscal Years 1993-1995, the total for this program is \$64 million. For fiscal years 1994-1998 an additional \$275 million has been proposed. [Appendix, Table 5] Generally, federal grant programs are used for capital expenditures not operating expenditures. If this program is structured like other federal grants, there is the danger that it would require the grantee to construct the fiber optic network. Although the constructor would own and control the network, this would duplicate the fiber optic networks that various communications companies are currently constructing. To avoid this duplication, these federal grant monies could be used for long-term leases from these communications companies. This would insure that federally funded fiber optic construction would not be wasted or redundant networks and that all consumers would benefit.

NTIA has already a broad national role in telecommunications policy and has sufficient authority to implement the Secretary of Commerce's goals in regard to the future information infrastructure.

Question 10. I see in President Clinton's economic package that he has included \$64 million dollars for a program for "information highways." Although we do not have all the details yet, it seems that this is a grant program for fiber optic or "broadband capacity highways." If this new program is approved how should it be structured? Currently, federal grant programs cover only capital expenditures not operating costs, should that be the case for this program?

Answer. If the grant of \$64 million is for the construction of a fiber optic network, it would be unnecessary and potentially counterproductive. The RBOC's and the IxCs have been deploying fiber in their networks for some time now and there is considerable penetration of fiber in long haul and interoffice links. Cable companies are also investing in fiber backbones. There are currently discussions under way on extending the fiber to the curb or to the home. These investments will look less attractive if the government undertakes to finance a parallel fiber optic network. Government investment may be offset or even exceeded by the resulting reduction in private investment. This possibility can be avoided by requiring that the grantee of any Federal award be required to use existing facilities whenever they are available.

A potential use of grant money that would not be redundant with ongoing efforts would be for promoting and supporting industry and academia in the development of Experimental Networks as outlined in the telecommunications CEO Policy Statement. The funds should not be used to construct, subsidize, or operate networks which carry commercial traffic or provide commercial network services (i.e., Production Networks as outlined in the CEO Policy Statements).

Question 11. On page 53 of the President's report entitled "A Vision Of Change For America," the Administration states its intention to spend several hundred million dollars on "information highway" demonstration projects such as distance learning, remote medical monitoring and diagnosis, and telecommuting. Would it be reasonable to assume that private investment in the commercialization of such new technology and services by telephone companies, cable companies, satellite companies and others in the private sector would provide a better return to the American

public? Do you see a situation where both government and private sector develop such technology and services in competition with each other?

Answer. Government investment in areas where the private sector is already investing money can have the effect of discouraging additional private investment. This effect is even greater if the government is seen as competing with the private sector. For this reason, it is important that the government work in partnership with the private sector and limit its role to support basic research and the development of precommercial technologies. The legislation should express these concerns explicitly. We believe, however, that it is an appropriate use of government funds to partner with industry on "demonstration projects" assuming the purpose of these projects is to educate people about the capabilities or potential capabilities of a national information infrastructure.

○

ISBN 0-16-040948-9

